# Appendix V5-3R

Hope Bay Project Aquatic Studies 2008

MAC RESOURCES

# HOPE BAY PROJECT
# AQUATIC STUDIES
# 2008

FINAL REPORT

Engineering Earth's Development, Preserving Earth's Integrity

Golder Associates

# HOPE BAY MINING LTD.

# 2008 ANNUAL HOPE BAY

# AQUATIC STUDIES REPORT

## - FINAL REPORT -

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# EXECUTIVE SUMMARY

In 2007, Newmont Mining Corporation purchased the Miramar Mining Company, which proposed to construct and operate a gold mine known as Doris North in the West Kitikmeot Region of Nunavut (NU). Newmont Mining Corporation created a Canadian subsidiary known as Hope Bay Mining Ltd. (HBML). In September of 2008, HBML announced a deferral of plans to build and operate the Doris North Project as previously proposed and permitted by Miramar Hope Bay Ltd. The mine, mill, and tailings facility have been placed on hold while HBML analyzes options for a multi-mine development in the Hope Bay Greenstone Belt. Other non-mine, Doris North infrastructure originally assessed and permitted as part of the Doris North Mine is now being used to support advanced exploration in the belt, some of which was previously run out of the Windy Camp. The infrastructure that has been built includes the temporary Roberts Bay jetty, a 900 m airstrip, a 118 person camp, and connecting roads. These were completed by HBML in 2008.

The Hope Bay Project consists of three main Project Areas: Doris, Madrid, and Boston. The Doris and Madrid Project Areas are located in the northern-most area of the Hope Bay Belt, approximately 685 km northeast of Yellowknife and 125 km southwest of Cambridge Bay. These areas are approximately 5 km south of Melville Sound on the Arctic Ocean, and include several lake systems that drain into Roberts Bay. The nearest communities are Umingmaktok, located 75 km to the southwest and Bathurst Inlet located 160 km to the southwest. Doris North is approximately one-third of the entire Doris deposit which is currently being considered, and Doris North infrastructure is located on Inuit owned land. The Boston Project Area is situated approximately 50 km south from the Madrid Project Area, and includes several lake and river systems that drain into Hope Bay via the Koignuk River.

The 2008 baseline sampling program for the Hope Bay Belt included the following: conducting snowcourse surveys; monitoring of seasonal water surface elevations of select waterbodies and discharge in associated outflows; monitoring of meteorological data to support lake evaporation estimates; collection of water quality and limnology data in selected lakes and streams in the Boston, Doris, and Madrid Project Areas; conducting fish species inventories in Aimaokatalok and Windy lakes; collecting additional fish for population characterization in Patch Lake; and sampling fish to determine use of spawning habitat by Arctic grayling in the lower reaches of the Koignuk River. This information will now be used to support monitoring of the Doris North infrastructure, and the permitting and monitoring requirements for HBML's new project at Hope Bay, the details of which will be contained in a new Project Description that will accompany

applications to amend or replace the existing package of regulatory documents obtained for the Doris North Project.

### Hydrology

The 2008 hydrology program is a continuation of the lake water level and stream discharge monitoring, and data collection for snow survey and weather from the previous years. Snow course surveys were conducted in the Doris and Boston areas from 16 to 21 May 2008 to measure the snowpack available to contribute to spring runoff. Twenty-eight survey plots on seven terrain types were measured, and the mean snow water equivalent depth computed was 93.1 mm for Doris area and 113.9 for Boston area.

The hydrometric monitoring started at the end of June and finished in mid-September. Measured lake levels indicate that spring melt began in early June, with the peak flow around 23 June, which was captured by most of the stations. At three stations (Aimaokatalok Lake, Doris Lake, and Tail Lake) the transducers and data loggers were left in place to collect data for the winter of 2007 - 2008.

The Doris weather station recorded a rainfall value of 156.5 mm from June to September, which is above the average value of 84.5 mm.

The lake water levels and stream discharge measurements show that 2008 was a wet year with above average values for water yield, rainfall, and snow water equivalent.

### Water Quality and Physical Limnology

Water quality sampling was conducted in the Boston Project Area (Aimaokatalok, Fickle Duck, Stickleback, and Reference lakes, as well as the corresponding outflow streams, Koignuk and Aimaokatalok rivers, and Hope Bay), the Doris Project Area (Doris, Little Roberts, Roberts, and Tail lakes, as well as the corresponding outflow streams, and Roberts Bay), and the Madrid Project Area (Glenn, Windy, Pelvic, Ogama, Wolverine, Patch, and P.O. lakes, as well as corresponding outflows for all lakes except Wolverine Lake, which doesn't have a permanent outflow).

All freshwater waterbodies within the Project Area were characterized by naturally soft water, with the majority of the lakes being moderately sensitive to acidification. The pH was typically near neutral to alkaline, although slightly acidic pH did occur under late winter ice-cover in several waterbodies.

Thermal stratification was observed in lakes within the Madrid Project Area, with the exception of P.O. Lake and Windy Lake. Hope Bay was stratified in July and August. In July, dissolved oxygen (DO) concentrations in Ogama and Pelvic lakes fell below the Canadian Water Quality Guideline (CWQG) of 6.5 mg/L for protection of early life stages of cold freshwater aquatic biota. Under ice-covered conditions in Tail Lake and Roberts Lake, DO concentrations were below the CWQG of 9.5 mg/L for protection of all life stages of cold freshwater aquatic biota.

Naturally occurring metals are often elevated in the Hope Bay Project Areas. In the Boston Project Area, Fickle Duck Lake and all sampled streams, with the exception of Stickleback Outflow, had natural total metal concentrations above one or more CWQGs. In the Doris Project Area, Doris, Little Roberts, and Tail lakes, and all outflow streams also had baseline total metal concentrations above one or more CWQGs. Baseline total metal concentrations in all of the Madrid Project Area waterbodies were above one or more CWQGs. Most of the waterbodies were above the CWQG for iron, with the exception of Aimaokatalok Outflow, Doris, and Roberts lakes, Patch Lake and Outflow, and Windy Lake and Outflow. All of the waterbodies, except Tail Lake, were above the CWQG for total aluminum. With the exception of the Boston Project waterbodies, most of the Doris and Madrid waterbodies were above the CWQG for selenium. Other baseline total metals that exceeded the CWQGs in some waterbodies included cadmium, chromium, and copper. For the marine sampling stations, only cadmium was above the CWQG in one Hope Bay sample.

A number of parameters, including iron, manganese, pH, chloride, and total dissolved solids were detected above Canadian Drinking Water Guidelines (CDWGs) in one or more samples from freshwater bodies in the Hope Bay Project study area. Iron was the most common parameter measured above the CDWG.

### Fish Populations

In the Boston Project Area, 464 fish representing eight species were encountered. Fish sampling was conducted in the south arm of Aimaokatalok Lake and the Koignuk River. The most abundant fish species captured was a YOY coregonid species in Aimaokatalok Lake (39.4%) followed by ninespine stickleback (26.7%), lake whitefish (11.9%), and lake trout (8.6%). Slimy sculpin, least cisco, cisco, Arctic grayling, and burbot were also captured.

In the Madrid Project Area, 778 fish representing five species were captured. Least cisco was captured primarily in Wolverine Lake and dominated the overall

catch (42.3%). The remainder of the catch consisted of cisco (38.4%), lake trout (6.6%), and ninespine stickleback (5.3%).

Statistical comparisons of fish length vs weight showed some statistically significant differences between lakes. Lake trout from Aimaokatalok Lake get slightly skinnier as they grow longer (negative allometric growth), whereas lake trout from Patch and Windy lakes get slightly fatter as they grow longer (positive allometric growth). Lake whitefish growth patterns also differed significantly between Patch and Aimaokatalok lakes, with fish in Patch Lake growing slightly fatter with length compared to fish from Aimaokatalok Lake. Cisco from Windy Lake get slightly fatter as they grow longer, wheras fish from Aimaokatalok and Patch lakes get slightly skinnier as they grow longer.

Lake trout, lake whitefish, and cisco growth patterns differed significantly among years in Patch Lake. In 2008, lake trout showed positive allometric growth (fish get fatter with length), and all other years showing slighty negative allometric growth (fish get skinnier with length). In all years except 2006, positive allometric growth was displayed in lake whitefish. Cisco growth was positively allometric in 1997 and 2007 and negatively allometric in 2006 and 2008.

### Fish Habitat

In the Madrid Project Area, shoreline and riparian habitat was visually assessed for Ogama, Patch, P.O., P.O. Inflow, P.O. Connector, and Wolverine lakes. Bathymetry maps were created for Ogama, P.O., P.O. Connector, and Wolverine lakes. Bathymetry data for Patch Lake was collected and submitted to SRK Consulting Ltd. by Golder Associates Ltd. (Burnaby) in 2006; this information is presented in this report to support the habitat discussion for Patch Lake.

In the Boston Project Area, shoreline and riparian habitat was visually assessed for Fickle Duck, Reference, and Stickleback lakes. Bathymetry data for Stickleback Lake was collected by Rescan Environmental in 1993; this information is presented in this report to support the habitat discussion for Stickleback Lake.

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## TABLE OF CONTENTS

**SECTION** **PAGE**

EXECUTIVE SUMMARY ..... I

ACKNOWLEDGEMENTS ..... V

ACRONYMS AND ABBREVIATIONS ..... XVII

LIST OF UNITS ..... XVIII

1 INTRODUCTION ..... 1
1.1 GENERAL ..... 1
1.2 SAMPLING PROGRAM IN 2008 ..... 3
1.3 OVERVIEW OF REPORT ..... 6

2 HYDROLOGY ..... 7
2.1 INTRODUCTION ..... 7
2.2 METHODS ..... 7
2.2.1 Hydrometry ..... 7
2.2.2 Snow Course Surveys ..... 12
2.2.3 Rainfall ..... 13
2.3 BOSTON PROJECT HYDROMETRY ..... 13
2.3.1 H83 Aimaokatalok River ..... 13
2.3.2 H84 Aimaokatalok Lake and Outflow ..... 15
2.3.3 H86 Fickle Duck Lake and Outflow ..... 17
2.3.4 H85 Koignuk River ..... 18
2.3.5 H87 Stickleback Lake and Outflow ..... 19
2.4 DORIS PROJECT HYDROMETRY ..... 21
2.4.1 H71 Doris Outflow and H74 Doris Lake ..... 21
2.4.2 H75 Tail Lake and H76 Tail Outflow ..... 24
2.4.3 H72 Roberts Lake and Outflow ..... 27
2.4.4 H73 Little Roberts Outflow ..... 28
2.5 MADRID PROJECT HYDROMETRY ..... 30
2.5.1 H93 Glenn Lake and Outflow ..... 30
2.5.2 H82 Ogama Lake and Outflow ..... 31
2.5.3 H81 Patch Lake and Outflow ..... 33
2.5.4 H89 P.O. Outflow ..... 34
2.5.5 H90 P.O. Lake ..... 36
2.5.6 H92 Windy Lake and Outflow ..... 37
2.5.7 H91 Wolverine Lake and Outflow ..... 39
2.6 SNOW COURSE SURVEYS ..... 40
2.7 RAINFALL ..... 46
2.8 HYDROMETRY DISCUSSION ..... 49
2.8.1 Boston Project Area ..... 49
2.8.2 Doris Project Area ..... 50
2.8.3 Madrid Project Area ..... 51
2.8.4 Summary ..... 52

3 WATER QUALITY ..... 53
3.1 INTRODUCTION ..... 53

3.2 METHODS ..... 53
3.2.1 Field Sampling Stations and Timing ..... 53
3.2.2 Field Sampling Procedures ..... 60
3.2.3 Laboratory Analytical Procedures ..... 62
3.2.4 Data Analysis ..... 63
3.2.5 Quality Assurance/Quality Control ..... 67
3.3 RESULTS AND DISCUSSION: LAKES ..... 67
3.3.1 Boston Project Area Lakes ..... 68
3.3.2 Doris Project Area Lakes ..... 79
3.3.3 Madrid Project Area Lakes ..... 91
3.3.4 Summary of Water Quality in Lakes ..... 112
3.4 RESULTS AND DISCUSSION: STREAMS AND RIVERS ..... 115
3.4.1 Boston Project Area Streams ..... 115
3.4.2 Doris Project Area Streams ..... 132
3.4.3 Madrid Project Area Streams ..... 142
3.4.4 Summary of Water Quality in Freshwater Streams ..... 158
3.5 RESULTS AND DISCUSSION: MARINE BAYS ..... 161
3.5.1 Boston Project Area Marine Site ..... 162
3.5.2 Doris Project Area Marine Site ..... 164

4 FISH POPULATIONS ..... 168
4.1 METHODS ..... 169
4.1.1 Angling ..... 169
4.1.2 Backpack Electrofishing ..... 169
4.1.3 Beach Seining ..... 169
4.1.4 Gill Netting ..... 173
4.1.5 Dip Netting ..... 173
4.1.6 Minnow Trapping ..... 173
4.1.7 Life History Data Collection ..... 173
4.1.8 Fish Tagging ..... 174
4.1.9 Data Analysis ..... 174
4.2 BOSTON PROJECT AREA LAKE COMMUNITIES ..... 176
4.2.1 Aimaokatalok Lake ..... 176
4.2.2 Koignuk River ..... 184
4.2.3 Boston Project Area Summary ..... 187
4.3 MADRID PROJECT AREA ..... 188
4.3.1 Patch Lake ..... 188
4.3.2 Windy Lake ..... 193
4.3.3 Wolverine Lake ..... 196
4.3.4 Madrid Project Area Summary ..... 200
4.3.5 Statistics for fish growth and condition ..... 200

5 FISH HABITAT ..... 208
5.1 METHODS ..... 208
5.1.1 Shoreline Substrate and Riparian Habitat ..... 208
5.1.2 Bathymetry and Physical Properties ..... 209
5.2 RESULTS ..... 210
5.2.1 Boston Project Area ..... 210
5.2.2 Madrid Project Area ..... 220

6 CLOSURE ..... 248

7 REFERENCES ..... 249

## LIST OF TABLES

Table 2.1 Site Visits to H83 Aimaokatalok River Hydrometric Station, 2008 ....14
Table 2.2 Site Visits to H84 Aimaokatalok Lake and Outflow Hydrometric Station, 2008 ....16
Table 2.3 Site Visits to H86 Fickle Duck Lake and Outflow Hydrometric Station, 2008 ....17
Table 2.4 Site Visits to H85 Koignuk River Hydrometric Station, 2008 ....19
Table 2.5 Site Visits to H87 Stickleback Lake and Outflow Hydrometric Station, 2008 ....20
Table 2.6 Site Visits to H71 Doris Outflow Hydrometric Station, 2008 ....21
Table 2.7 Site Visits to H74 Doris Lake Hydrometric Station, 2008 ....22
Table 2.8 Site Visits to H75 Tail Lake Hydrometric Station, 2008 ....24
Table 2.9 Site Visits to H76 Tail Outflow Hydrometric Station, 2008 ....26
Table 2.10 Site Visits to H72 Roberts Lake and Outflow Hydrometric Station, 2008 ....27
Table 2.11 Site Visits to H73 Little Roberts Outflow Hydrometric Station, 2008 ....29
Table 2.12 Site Visits to H93 Glenn Lake and Outflow Hydrometric Station, 2008 ....30
Table 2.13 Site Visits to H82 Ogama Lake and Outflow Hydrometric Station, 2008 ....32
Table 2.14 Site Visits to H81 Patch Lake and Outflow Hydrometric Station, 2008 ....33
Table 2.15 Site Visits to H89 P.O. Outflow Hydrometric Station, 2008 ....35
Table 2.16 Site Visits to H90 P.O. Lake Hydrometric Station, 2008 ....36
Table 2.17 Site Visits to H92 Windy Lake and Outflow Hydrometric Station, 2008 ....38
Table 2.18 Site Visits to H91 Wolverine Lake and Outflow Hydrometric Station, 2008 ....39
Table 2.19 Snow Course Survey Data for Boston Project Area, May 2008 ....43
Table 2.20 Snow Course Survey Data for Doris and Madrid Project Areas, May 2008 ....44
Table 2.21 Monthly Rainfall Measured at Doris Meteorological Station, May – October 2008 ....46
Table 2.22 Monthly and Annual Rainfall at Doris Weather Station, 2005 – 2008 ....48
Table 2.23 Calculated Water Yields for Aimaokatalok Lake and Stickleback Lake Watersheds, 2008 ....49
Table 2.24 Calculated Water Yields for Doris, Tail, Roberts and Little Roberts Watersheds, 2008 ....51
Table 3.1 Sampling Date and Number of Water Samples Collected in the Boston Project Area Lakes and Hope Bay, 2008 ....56
Table 3.2 Sampling Date and Number of Water Samples Collected in the Boston Project Area Streams, 2008 ....57
Table 3.3 Sampling Date and Number of Water Samples Collected in the Doris Project Area Lakes and Roberts Bay, 2008 ....58
Table 3.4 Sampling Date and Number of Water Samples Collected in the Doris Project Area Streams, 2008 ....58
Table 3.5 Sampling Date and Number of Water Samples Collected in the Madrid Project Area Lakes, 2008 ....59
Table 3.6 Sampling Date and Number of Water Samples Collected in the Madrid Project Area Streams, 2008 ....60
Table 3.7 Water Quality Parameters and Corresponding Minimum Reported Values (MRVs) for Freshwater Samples from the Boston, Madrid and Doris Project Areas, 2008 ....64
Table 3.8 Water Quality Parameters and Corresponding Reported Detection Limits (RDLs) for Marine Samples from the Boston and Madrid Project Areas, 2008 ....65
Table 3.9 Quality Assurance/Quality Control Samples for the Boston, Madrid and Doris Project Areas, 2008 ....68

Table 3.10 Baseline Parameters Above Guidelines in the Boston Project Area Lakes, 2008 ....78
Table 3.11 Summary of Select Baseline Water Quality Parameters in the Boston Project Area Lakes, 2006-2008 ....79
Table 3.12 Baseline Parameters above Guidelines in the Doris Project Area Lakes, 2008 ....90
Table 3.13 Summary of Select Baseline Water Quality Parameters in the Doris Project Area Lakes, 2003-2008 ....91
Table 3.14 Baseline Parameters above Guidelines in the Madrid Project Area Lakes, 2008 ....110
Table 3.15 Summary of Select Baseline Water Quality Parameters in the Madrid Project Area Lakes, 2006-2008 ....112
Table 3.16 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Boston and Doris Project Areas, 2008 ....113
Table 3.17 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Madrid Project Area, 2008 ....114
Table 3.18 Baseline Parameters above Guidelines in the Boston Project Area Streams, 2008 ....130
Table 3.19 Summary of Select Baseline Water Quality Parameters in the Boston Project Area Streams, 2006-2008 ....132
Table 3.20 Baseline Parameters above Guidelines in the Doris Project Area Streams, 2008 ....141
Table 3.21 Summary of Select Baseline Water Quality Parameters in the Doris Project Area Streams, 2003-2008 ....142
Table 3.22 Guideline Exceedences in the Madrid Project Area Streams, 2008 ....156
Table 3.23 Summary of Select Baseline Water Quality Parameters in the Madrid Project Area Streams, 2008 ....158
Table 3.24 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Boston and Doris Project Areas, 2008 ....160
Table 3.25 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Madrid Project Areas, 2008 ....161
Table 3.26 Summary of Select Baseline Water Quality Parameters in Marine Waters within the Boston and Doris Project Areas, 2008 ....166
Table 3.27 Baseline Parameters Above Guidelines in Marine Waters within the Boston and Doris Project Areas, 2008 ....167
Table 4.1 Common and Scientific Names of Fish Species Captured in the Hope Bay Belt, 2008 ....174
Table 4.2 Fish Species and Number Captured in Aimaokatalok Lake, 2008 ....177
Table 4.3 Fish Species and Number of Fish Captured in Koignuk River, 2008 ....184
Table 4.4 Summary of Fish Captured in the Boston Project Area, 2008 ....187
Table 4.5 Fish Species and Number Captured in Patch Lake, 2008 ....188
Table 4.6 Fish Species and Number Captured in Windy Lake, 2008 ....194
Table 4.7 Fish Species and Number Captured in Wolverine Lake, 2008 ....198
Table 4.8 Summary of Fish Captured in the Madrid Project Area, 2008 ....200
Table 4.9 Lake-Specific Values of Slope (b) and Sample Sizes for Log-weight vs. Log-length Regressions, 2008 ....201
Table 4.10 Year-Specific Values of Slope (b) and Sample Sizes for Log-Weight vs. Log-Length Regressions in Patch Lake ....204
Table 5.1 Physical Properties of Fickle Duck Lake ....210
Table 5.2 Physical Properties of Reference Lake ....213
Table 5.3 Physical Properties of Stickleback Lake ....216
Table 5.4 Physical Properties of Ogama Lake ....221
Table 5.5 Physical Properties of Patch Lake ....225

Table 5.6 Physical Properties of P.O. Lake ....231
Table 5.7 Physical Properties of P.O. Connector Lake ....235
Table 5.8 Physical Properties of P.O. Inflow Lake ....240
Table 5.9 Physical Properties of Wolverine Lake ....243

## LIST OF FIGURES

Figure 1.1 Project Location Map ....2
Figure 1.2 2008 Waterbodies Sampled, Boston Project Area ....4
Figure 1.3 2008 Waterbodies Sampled, Doris and Madrid Project Areas ....5
Figure 2.1 2008 Hydrometric Station Locations, Boston Project Area ....9
Figure 2.2 2008 Hydrometric Station Locations, Doris and Madrid Project Areas ....10
Figure 2.3 Hydrograph for H83 Aimaokatalok River, June to September 2008 ....14
Figure 2.4 Hydrograph for H84 Aimaokatalok Lake and Outflow, 2007 ....15
Figure 2.5 Hydrograph for H84 Aimaokatalok Lake and Outflow, January to October 2008 ....16
Figure 2.6 Hydrograph for H86 Fickle Duck Lake and Outflow, June to September 2008 ....18
Figure 2.7 Hydrograph for H85 Koignuk River, June to September 2008 ....19
Figure 2.8 Hydrographs for H87 Stickleback Lake and Outflow, June to September 2008 ....20
Figure 2.9 Hydrograph for H71 Doris Outflow, June to September 2008 ....22
Figure 2.10 Hydrograph and Water Temperatures for H74 Doris Lake, 2007 ....23
Figure 2.11 Hydrograph and Water Temperatures for H74 Doris Lake, January to September 2008 ....23
Figure 2.12 Hydrograph and Water Temperature for H75 Tail Lake, 2007 ....25
Figure 2.13 Hydrograph and Water Temperatures for H75 Tail Lake, January to September 2008 ....25
Figure 2.14 Hydrograph for H76 Tail Outflow, June to September 2008 ....26
Figure 2.15 Hydrograph for H72 Roberts Lake and Outflow, June to September 2008 ....28
Figure 2.16 Hydrograph for H73 Little Roberts Outflow, June to September 2008 ....29
Figure 2.17 Hydrograph for H93 Glenn Lake and Outflow, June to September 2008 ....31
Figure 2.18 Hydrograph for H82 Ogama Lake and Outflow, June to September 2008 ....32
Figure 2.19 Hydrograph for H81 Patch Lake and Outflow, June to September 2008 ....34
Figure 2.20 Hydrograph for H89 P.O. Outflow, June to September 2008 ....35
Figure 2.21 Hydrograph for P.O. Lake, June to September 2008 ....37
Figure 2.22 Hydrograph for H92 Windy Lake and Outflow, June to September 2008 ....38
Figure 2.23 Hydrograph for H91 Wolverine Lake and Outflow, June to September 2008 ....40
Figure 2.24 2008 Snow Course Survey Sites and Snow Water Equivalents, Boston Project Area ....41
Figure 2.25 2008 Snow Course Survey Sites and Snow Water Equivalents, Doris and Madrid Project Areas ....42
Figure 2.26 Snow Course Survey Data for Boston Project Area, May 2008 ....45
Figure 2.27 Snow Course Survey Data for Doris and Madrid Project Areas, May 2008 ....45
Figure 2.28 Rainfall Data from Doris Weather Station, June to September 2008 ....47
Figure 2.29 Monthly and Annual Rainfall Data from Doris Meteorological Station ....48
Figure 3.1 2008 Water Quality Sampling Stations, Boston Project Area ....54
Figure 3.2 2008 Water Quality Sampling Stations, Doris and Madrid Project Areas ....55
Figure 3.3 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Aimaokatalok Lake – Site 4, 2008 ....70

Figure 3.4 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Aimaokatalok Lake – Site 6, 2008 ....71
Figure 3.5 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Fickle Duck Lake, 2008 ....72
Figure 3.6 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Reference Lake, 2008 ....75
Figure 3.7 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Stickleback Lake, 2008 ....76
Figure 3.8 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Doris Lake, 2008 ....80
Figure 3.9 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Little Roberts Lake, 2008 ....82
Figure 3.10 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Roberts Lake, 2008 ....85
Figure 3.11 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Tail Lake, 2008 ....87
Figure 3.12 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Glenn Lake, 2008 ....93
Figure 3.13 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Ogama Lake, 2008 ....95
Figure 3.14 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Patch Lake, 2008 ....97
Figure 3.15 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Pelvic Lake, 2008 ....100
Figure 3.16 Temperature and Dissolved Oxygen Profiles and Secchi Depths in P.O. Lake, 2008 ....102
Figure 3.17 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Windy Lake, 2008 ....104
Figure 3.18 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Wolverine Lake, 2008 ....106
Figure 3.19 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok Inflow, June to September, 2008 ....117
Figure 3.20 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok River, June to September, 2008 ....118
Figure 3.21 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok Outflow, June to September, 2008 ....120
Figure 3.22 Daily Maximum, Minimum, and Mean Water Temperatures in Fickle Duck Inflow, June to September, 2008 ....122
Figure 3.23 Daily Maximum, Minimum, and Mean Water Temperatures in Koignuk River, June to September, 2008 ....124
Figure 3.24 Daily Maximum, Minimum, and Mean Water Temperatures in Reference Outflow, June to September, 2008 ....126
Figure 3.25 Daily Maximum, Minimum, and Mean Water Temperatures in Stickleback Outflow, June to September, 2008 ....128
Figure 3.26 Daily Maximum, Minimum, and Mean Water Temperatures in Doris Outflow, June to September, 2008 ....133
Figure 3.27 Daily Maximum, Minimum, and Mean Water Temperatures in Little Roberts Outflow, June to September, 2008 ....135
Figure 3.28 Daily Maximum, Minimum, and Mean Water Temperatures in Roberts Outflow, June to September, 2008 ....137
Figure 3.29 Daily Maximum, Minimum, and Mean Water Temperatures in Tail Outflow, June to September, 2008 ....139

Figure 3.30 Daily Maximum, Minimum, and Mean Water Temperatures in Glenn Outflow, June to September, 2008 ....143
Figure 3.31 Daily Maximum, Minimum, and Mean Water Temperatures in Ogama Outflow, June to September, 2008 ....145
Figure 3.32 Daily Maximum, Minimum, and Mean Water Temperatures in Patch Outflow, June to September, 2008 ....147
Figure 3.33 Daily Maximum, Minimum, and Mean Water Temperatures in Pelvic Outflow, June to September, 2008 ....149
Figure 3.34 Daily Maximum, Minimum, and Mean Water Temperatures in P.O. Outflow, June to September, 2008 ....151
Figure 3.35 Daily Maximum, Minimum, and Mean Water Temperatures in Windy Outflow, June to September, 2008 ....153
Figure 3.36 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Hope Bay, 2008 ....163
Figure 3.37 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Roberts Bay, 2008 ....165
Figure 4.1 2008 Fish Sampling Stations, Boston Project Area ....170
Figure 4.2 2008 Koignuk River Fish Sampling Stations and Potential Spawning Areas, Boston Project Area ....171
Figure 4.3 2008 Fish Sampling Stations, Madrid Project Area ....172
Figure 4.4 Weight-Length Relationship of Cisco in Aimaokatalok Lake, 2008 ....178
Figure 4.5 Weight-Length Relationship of Least Cisco in Aimaokatalok Lake, 2008 ....178
Figure 4.6 Length-Frequency Distribution of Cisco in Aimaokatalok Lake, 2008 ....179
Figure 4.7 Length-Frequency Distribution of Least Cisco in Aimaokatalok Lake, 2008 ....179
Figure 4.8 Weight-Length Relationship of Lake Trout in Aimaokatalok Lake, 2008 ....180
Figure 4.9 Length-Frequency Distribution of Lake Trout in Aimaokatalok Lake, 2008 ....181
Figure 4.10 Weight-Length Relationship of Lake Whitefish in Aimaokatalok lake, 2008 ....182
Figure 4.11 Length-Frequency Distribution of Lake Whitefish in Aimaokatalok Lake, 2008 ....182
Figure 4.12 Length-Frequency Distribution of Ninespine Stickleback in Aimaokatalok Lake, 2008 ....183
Figure 4.13 Length-Frequency Distribution of Ninespine Stickleback in Koignuk River, 2008 ....186
Figure 4.14 Length-Frequency Distribution of Slimy Sculpin in Koignuk River, 2008 ....187
Figure 4.15 Weight-Length Relationship of Lake Trout in Patch Lake, 2008 ....189
Figure 4.16 Length-Frequency Distribution of Lake Trout in Patch Lake, 2008 ....190
Figure 4.17 Weight-Length Relationship of Cisco in Patch Lake, 2008 ....191
Figure 4.18 Length-Frequency Distribution of Cisco in Patch Lake, 2008 ....191
Figure 4.19 Length-Frequency Distribution of Lake Whitefish in Patch Lake, 2008 ....192
Figure 4.20 Weight-Length Relationship of Lake Whitefish in Patch Lake, 2008 ....193
Figure 4.21 Weight-Length Relationship of Lake Trout in Windy Lake, 2008 ....195
Figure 4.22 Length-Frequency Distribution of Lake Trout in Windy Lake, 2008 ....195
Figure 4.23 Weight-Length Relationship of Cisco in Windy Lake, 2008 ....197
Figure 4.24 Length-Frequency Distribution of Cisco in Windy Lake, 2008 ....197
Figure 4.25 Weight-Length Relationship of Least Cisco in Wolverine Lake, 2008 ....199
Figure 4.26 Length-Frequency Distribution of Least Cisco in Wolverine Lake, 2008 ....199
Figure 4.27 Log-Transformed Weight-Length Regressions of Lake Trout in Aimaokatalok, Patch, and Windy Lakes, 2008 ....202
Figure 4.28 Log-Transformed Weight-Length Regressions of Lake Whitefish in Aimaokatalok and Patch Lakes, 2008 ....203
Figure 4.29 Log-Transformed Weight-Length Regressions of Cisco in Aimaokatalok, Patch, and Windy Lakes, 2008 ....203

Figure 4.30 Log-Transformed Weight-Length Regressions of Lake Trout in Patch Lake, 1997, and 2006-2008 ....205
Figure 4.31 Log-Transformed Weight-Length Regressions of Lake Whitefish in Patch Lake, 1997, and 2006-2008 ....206
Figure 4.32 Log-Transformed Weight-Length Regressions of Cisco in Patch Lake, 1997 and 2006-2008 ....207
Figure 5.1 Fickle Duck Lake Nearshore Substrate and Riparian Habitat ....211
Figure 5.2 Reference Lake Nearshore Substrate and Riparian Habitat ....214
Figure 5.3 Depth – Area and Volume Hypsograph of Stickleback Lake ....216
Figure 5.4 Stickleback Lake Bathymetry ....217
Figure 5.5 Stickleback Lake Nearshore Substrate and Riparian Habitat ....219
Figure 5.6 Depth – Area and Volume Hypsograph of Ogama Lake ....221
Figure 5.7 Ogama Lake Bathymetry ....223
Figure 5.8 Ogama Lake Nearshore Substrate and Riparian Habitat ....224
Figure 5.9 Depth – Area and Volume Hypsograph of Patch Lake ....226
Figure 5.10 Patch Lake Bathymetry ....227
Figure 5.11 Patch Lake Nearshore Substrate and Riparian Habitat (North End) ....228
Figure 5.12 Patch Lake Nearshore Substrate and Riparian Habitat (South End) ....229
Figure 5.13 Depth – Area and Volume Hypsograph of P.O. Lake ....232
Figure 5.14 P.O. Lake Bathymetry ....233
Figure 5.15 P.O. Lake Nearshore Substrate and Riparian Habitat ....234
Figure 5.16 Depth - Area and Volume Hypsograph of P.O. Connector Lake ....236
Figure 5.17 P.O. Connector Lake Bathymetry ....237
Figure 5.18 P.O. Connector Lake Nearshore Substrate and Riparian Habitat ....238
Figure 5.19 P.O. Inflow Lake Nearshore Substrate and Riparian Habitat ....241
Figure 5.20 Depth – Area and Volume Hypsograph of Wolverine Lake ....243
Figure 5.21 Wolverine Lake Bathymetry ....244
Figure 5.22 Wolverine Lake Neashore Substrate and Riparian Habitat ....246

## LIST OF PHOTOGRAPHS

Photo 5.1 Vegetated Area at Fickle Duck Outflow, 2006 ....212
Photo 5.2 Overhanging Shrubs on the South-West Shore of Fickle Duck Lake, 2006 ....212
Photo 5.3 Cobble Substrate at the South End of Reference Lake, 2006 ....215
Photo 5.4 Flooded Vegetation at the North End of Reference Lake, 2006 ....215
Photo 5.5 Overhanging Shrubs on the South-West Shore of Stickleback Lake, 2006 ....218
Photo 5.6 Vegetated Shoreline of Stickleback Lake, 2006 ....220
Photo 5.7 Bedrock Outcrop on West Shore of Ogama Lake, 2006 ....222
Photo 5.8 Sand Substrate on South Shore of Ogama Lake, 2006 ....222
Photo 5.9 Bedrock Outcrop on East Shore of Patch Lake, 2006 ....230
Photo 5.10 Gravel and Sand Beach on the North-West End of Patch Lake, 2006 ....230
Photo 5.11 Slumping Banks on East Shore of P.O. Lake, 2006 ....232
Photo 5.12 Overhanging Vegetation on the West Shore of P.O. Lake, 2006 ....235
Photo 5.13 Bedrock on East Shore of P.O. Connector Lake, 2006 ....239
Photo 5.14 Submerged Aquatic Vegetation on the South Shore of P.O. Connector Lake, 2006 ....239
Photo 5.15 Emergent Vegetation on the North-East Shore of P.O. Inflow Lake, 2006 ....242
Photo 5.16 Shoreline Vegetation on the South-East Shore of P.O. Inflow Lake, 2006 ....242
Photo 5.17 Cobble Substrate on North-East Shore of Wolverine Lake, 2006 ....245
Photo 5.18 Emergent Aquatic Vegetation at the South-East End of Wolverine Lake, 2006 ....247

## LIST OF APPENDICES

Appendix A Hydrology Data
Appendix B Water Quality Data
Appendix C Fish Data

# ACRONYMS AND ABBREVIATIONS

| | | | |
|---|---|---|---|
| AB | Alberta | $MgCO_3$ | magnesium cobalt |
| ADCP | Acoustic Doppler Current Profiler | MMER | *Metal Mining Effluent Regulations* |
| ANCOVA | Analysis of Covariance | $N^{2+}$ | Nitrogen (II) ion |
| ARC | Alberta Research Council | N/A | Not applicable |
| Aug | August | NAD | North American Datum |
| BC | British Columbia | NIRB | Nunavut Impact Review Board |
| $CaCO_3$ | calcium carbonate | No. | Number |
| CCME | Canadian Council of Ministers of the Environment | NU | Nunavut |
| $Cd^{2+}$ | Cadmium (II) ion | MRV | minimum reportable value |
| CDWG | Canadian Drinking Water Guideline | OECD | Organisation for Economic Co-operation and Development |
| Chl *a* | chlorophyll *a* | $Pb^{2+}$ | Lead (II) ion |
| COC | chain-of-custody | PIT | Passive Integrated Transponder |
| CPUE | Catch-per-unit-effort | QA/QC | quality assurance/quality control |
| CR(III) | Trivalent chromium | RPD | relative percent difference |
| CR(VI) | Hexavalent chromium | Sep | September |
| $Cu^{2+}$ | Copper (II) ion | SRC | Saskatchewan Research Council |
| CWQG | Canadian Water Quality Guideline | TDS | total dissolved solids |
| DO | dissolved oxygen | TRIX | Trophic Index for Marine Systems |
| GPS | Global Positioning System | TSS | total suspended solids |
| HBML | Hope Bay Mining Ltd. | USEPA | United States Environmental Protection Agency |
| Jul | July | UTM | Universal Transverse Mercator |
| Jun | June | YOY | Young-of-the-year |
| K | Fulton's condition factor | | |

# LIST OF UNITS

| | |
|---|---|
| % | percent |
| ± | plus or minus |
| ≤ | less than or equal to |
| ≥ | greater than or equal to |
| > | greather than |
| < | less than |
| °C | degrees Celsius |
| Bq/L | Becquerel per litre |
| cm | centimetre |
| ha | hectares |
| g | grams |
| km | kilometre |
| L | litre |
| m | metre |
| $m^3$ | cubic metres |
| mm | millimetre |
| mg/L | milligrams per litre |
| $mg/m^3$ | milligram per cubic metre |
| mL | millilitre |
| g/L | nanograms per litre |
| µg/L | micrograms per litre |
| µm | micrometre |
| µS/cm | microSiemens per centimetre |

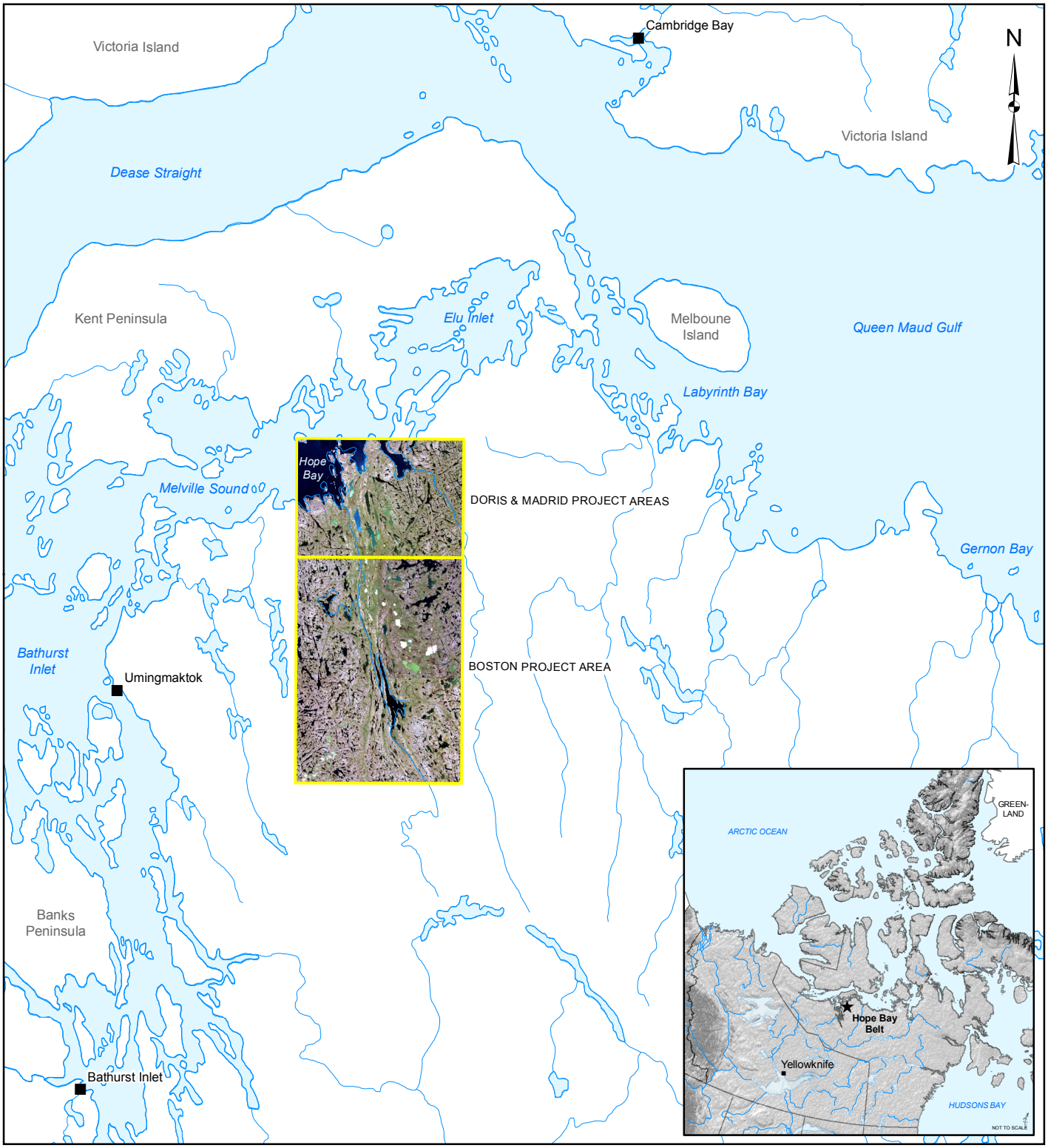
# 1 INTRODUCTION

## 1.1 GENERAL

The Doris North Project was approved by the Nunavut Impact Review Board (NIRB), and a subsequent Project Certificate was issued to Miramar Mining Corporation for the project in 2007. In December 2007, Miramar Hope Bay Ltd. and their project at Hope Bay were purchased by Newmont Mining Corporation and reorganized as an affiliate known as Hope Bay Mining Ltd. (HBML). As of September 2008, the mine, mill, and tailings facility have been placed on hold while HBML analyzes options for development of a multi-mine project in the Hope Bay Greenstone Belt. To support advanced exploration and project feasibility studies in the belt, HBML completed the following infrastructure in 2007 and 2008: the temporary port in Roberts Bay, a 5 000 000 L tank farm near Roberts Bay, two developed rock quarries, an all-weather road from Roberts Bay to Doris Lake, a 900 m long airstrip, and a 118 person camp at Doris Lake.

The Hope Bay Project consists of three main Project Areas: Doris, Madrid, and Boston. The Doris and Madrid Project Areas are located in the northern-most area of the Hope Bay Belt, approximately 685 km northeast of Yellowknife and 125 km southwest of Cambridge Bay. These areas are approximately 5 km south of Melville Sound on the Arctic Ocean, and include several lake systems that drain into Roberts Bay. The nearest communities are Umingmaktok, located 75 km to the southwest and Bathurst Inlet located 160 km to the southwest (Figure 1.1). Doris North is approximately one-third of the entire Doris deposit which is currently being considered, and Doris North infrastructure is located on Inuit owned land. The Boston Project Area is situated approximately 50 km south from the Madrid Project Area, and includes several lake and river systems that drain into Hope Bay via the Koignuk River.

Previous environmental baseline studies were carried out within the Boston Project Area from 1992 to 2000 and from 2006 to 2007. Within the Doris Project Area, baseline studies were carried out from 1995 to 2007. Madrid Project Area baseline studes were conducted from 1995 to 2000 and 2006 to 2007. The aquatic environmental baseline information collected prior to 2002 was synthesized and consolidated into two data compilation reports (RL&L/Golder 2002, Golder 2008a). Annual studies have been conducted by Golder since 2002 (RL&L/Golder 2003a, 2003b, Golder 2005, 2006a, 2007, 2008b, 2008c).




**LEGEND**

- COMMUNITY
- WATERCOURSE
- WATERBODY
- STUDY AREA

40 0 40

SCALE 1:1325000 KILOMETRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**PROJECT LOCATION MAP**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 1 |
|---|---|---|---|---|
| DESIGN | AH | 24 Sep. 2008 | | |
| GIS | RC | 29 Dec. 2008 | | |
| CHECK | AH | 29 Dec. 2008 | | |
| REVIEW | GA | 29 Dec. 2008 | | |

**FIGURE: 1.1**

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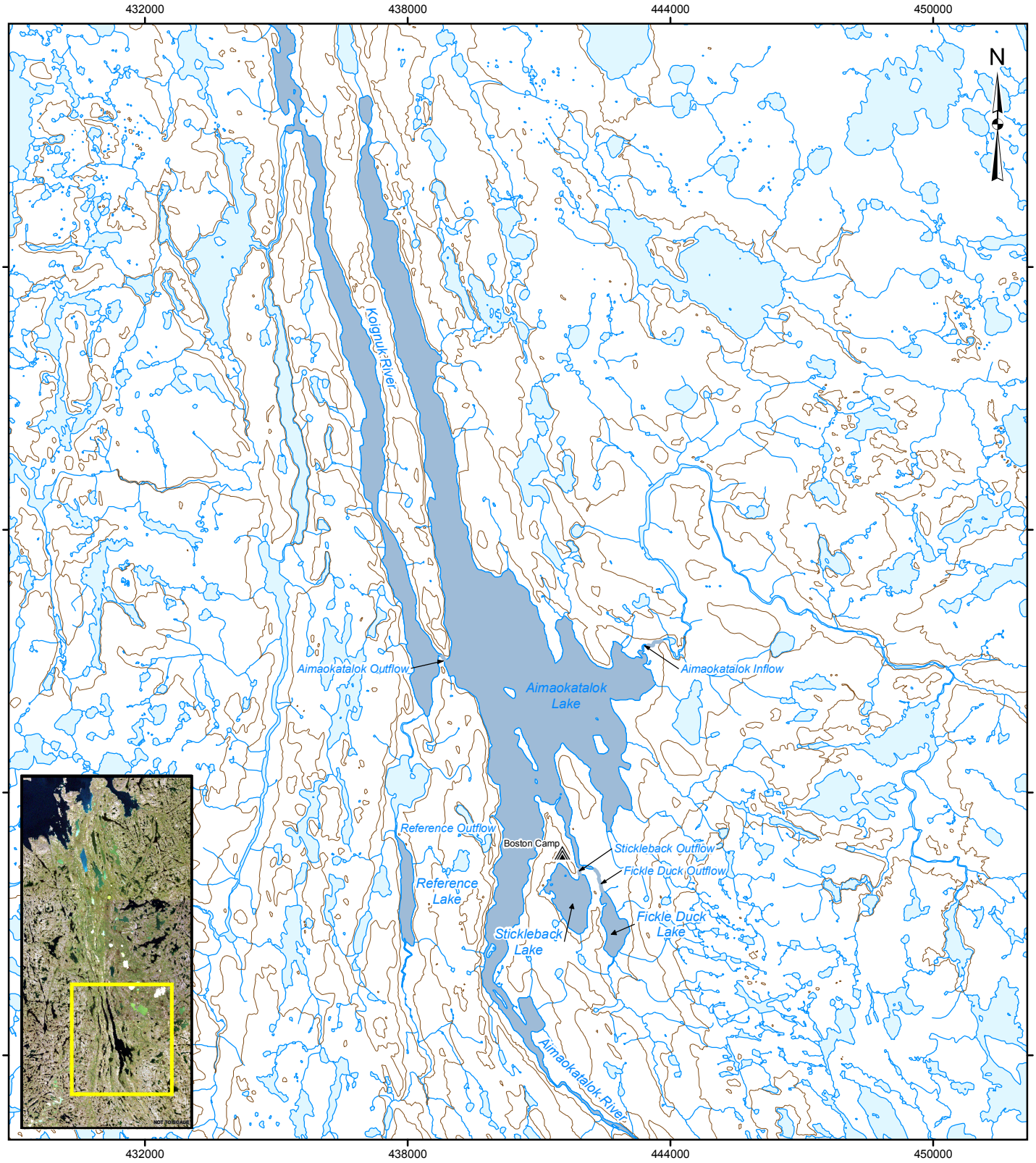
## 1.2 SAMPLING PROGRAM IN 2008

Field studies were conducted by Golder Associates Ltd. in 2008 to gather additional baseline data regarding species composition and abundance in lakes and streams that potentially could be affected by the future development in the Boston, Doris, and Madrid Project Areas. The proposed studies built upon, rather than duplicated, surveys conducted in the waterbodies during the 1992 to 2007 period. The 2008 field program was designed to address several specific objectives:

- Sampling of water quality in selected lakes and streams in the Boston Project Area (Aimaokatalok, Fickle Duck, Reference, and Stickleback lakes; corresponding outflow streams; Koignuk and Aimaokatalok rivers; Aimaokatalok Inflow; and Hope Bay) (Figures 1.2 and 1.3);
- Sampling of water quality in selected lakes and streams in the Doris Project Area (Doris, Little Roberts, Roberts, and Tail lakes; corresponding outflow streams; and Roberts Bay) (Figure 1.3);
- Sampling of water quality in selected lakes and streams in the Madrid Project Area (Glenn, Ogama, Patch, Pelvic, P.O., Windy, and Wolverine lakes, and corresponding outflow streams) (Figure 1.3);
- Conducting snowcourse surveys in the Doris, Patch, and Aimaokatalok lake watersheds;
- Monitoring of meteorological data including rainfall and other parameters to support lake evaporation estimates in the Aimaokatalok Lake watershed;
- Monitoring of seasonal water surface elevations at Boston, Doris, and Madrid Project Area lakes, and discharge in associated outflows;
- Sampling to determine fish species presence and relative abundance in Aimaokatalok and Windy lakes;
- Collecting additional fish for population characterization in Patch Lake; and
- Sampling fish to determine use of spawning habitat by Arctic grayling in the lower reaches of the Koignuk River.

Based on discussion with HBML, the field studies were limited primarily to components that required long-term data sets (e.g., water quality, hydrology, meteorology) or multiyear programs (e.g., fish, habitat); components that would require only one year of sampling (e.g., lower trophic components, etc.) were postponed until the expanded project is better defined. The field program for 2008 was conducted between 15 May and 15 September.




**LEGEND**

- CAMP
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- STUDY AREA WATERCOURSE
- STUDY AREA WATERBODY
- WATERBODY

4000 0 4000

SCALE 1:125000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 WATERBODIES SAMPLED**
**BOSTON PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
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| GIS | RC | 29 Dec. 2008 | | |
| CHECK | AH | 29 Dec. 2008 | | |
| REVIEW | GA | 29 Dec. 2008 | | |

**FIGURE: 1.2**

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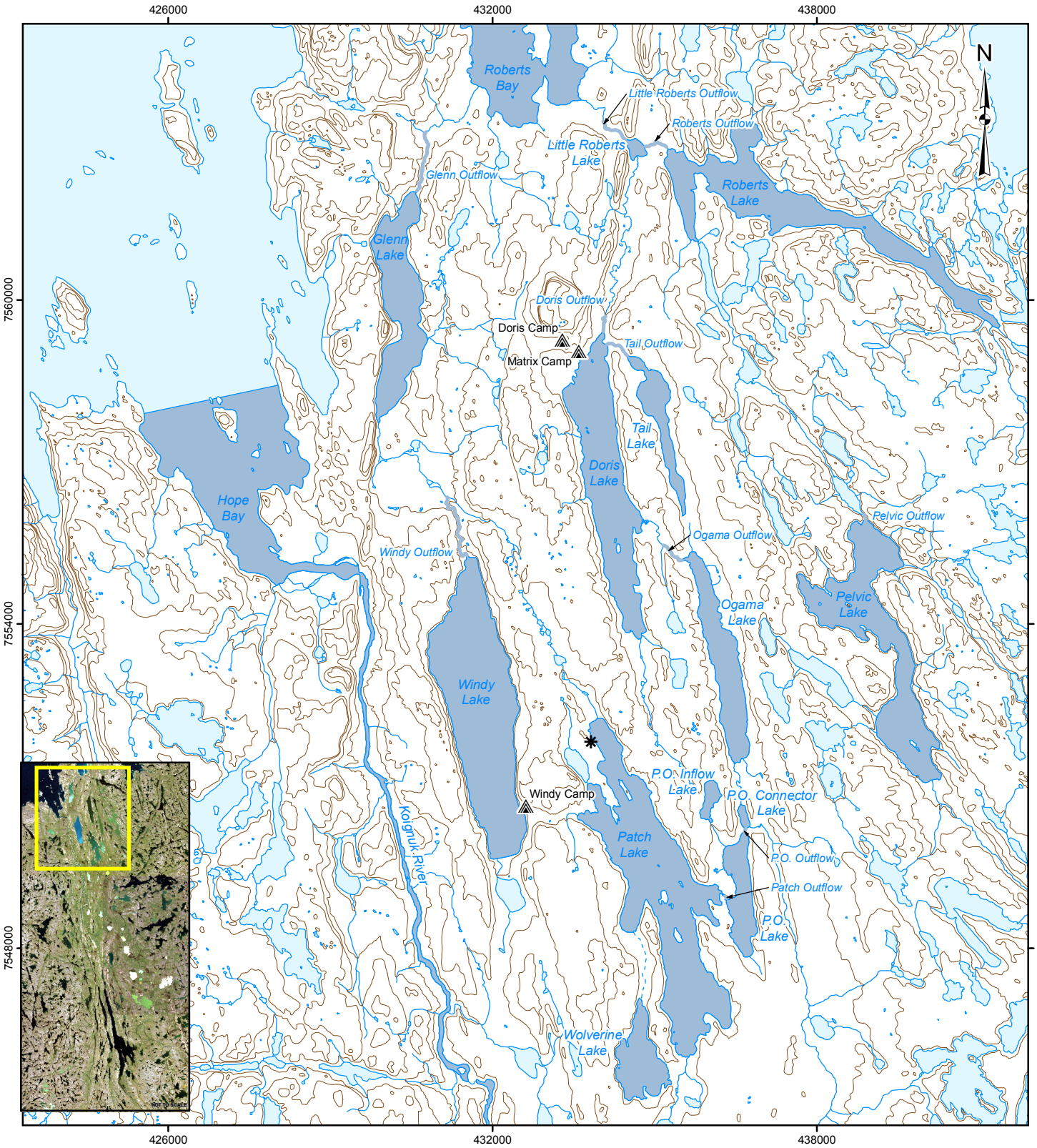



**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- STUDY AREA WATERCOURSE
- STUDY AREA WATERBODY
- WATERBODY

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 WATERBODIES SAMPLED**
**DORIS AND MADRID PROJECT AREAS**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 9 Jan. 2009 | | |
| CHECK | AH | 9 Jan. 2009 | | |
| REVIEW | GA | 9 Jan. 2009 | | |

**FIGURE: 1.3**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig1_3_AQ_SL_WaterbodiesSampled_Madrid08_09Jan2009.mxd

## 1.3 OVERVIEW OF REPORT

To facilitate subsequent integration of the 2008 data with historical data, the format and organization of this report closely follows the outline used in the historical data summary reports (RL&L/Golder 2002; Golder 2008a). This report is organized by major disciplines with a separate discussion for each waterbody sampled. Environmental disciplines are presented as separate sections in the following order: hydrology, physical limnology and water quality, fish populations, and fish habitat. Raw data and analytical results are provided as appendices at the end of this report.

# 2 HYDROLOGY

## 2.1 INTRODUCTION

The hydrology program conducted by Golder in the Boston, Doris, and Madrid Project Areas is in the sixth year of data collection for the Doris Project Area and the third for the Boston and Madrid Project Areas. The objective of the data collection is to characterize the hydrology and hydrometeorology for key waterbodies in these areas, including annual and seasonal wet and dry conditions.

Runoff from small Arctic watersheds is dominated by lake storage and by the conditions at individual lake outlets. Regional hydrological analysis methods of predicting the flow regimes of ungauged watersheds are often inappropriate in this context. The data collected under this program are intended to be used to develop water balance models for these small watersheds, to allow mean and wet and dry extreme (e.g., 100-year flood and drought) conditions to be characterized on the basis of a relatively short (e.g., three to six year) data set.

## 2.2 METHODS

The monitoring approach is to select key watersheds that are likely to be affected by mine development and to monitor lake water levels and watercourse discharges concurrently with snowpack, rainfall, temperature, and other meteorological parameters. This provides data for model development, including stage-discharge rating curves at lake outlets, as well as data for model calibration and verification. The monitoring program implemented during development will be derived from the baseline model and will be used for model validation, and for monitoring of project effects through construction, operations, and closure.

In some situations, logistics and ice conditions mean that early and late season flows cannot be collected for some waterbodies. The data that are collected, even if they do not include flood peaks or are not continuous, are still of value for model development, calibration, and validation.

### 2.2.1 Hydrometry

In 2008, the hydrology program monitored lake water levels and stream discharge during the open water season at 18 hydrometric stations in the following locations:

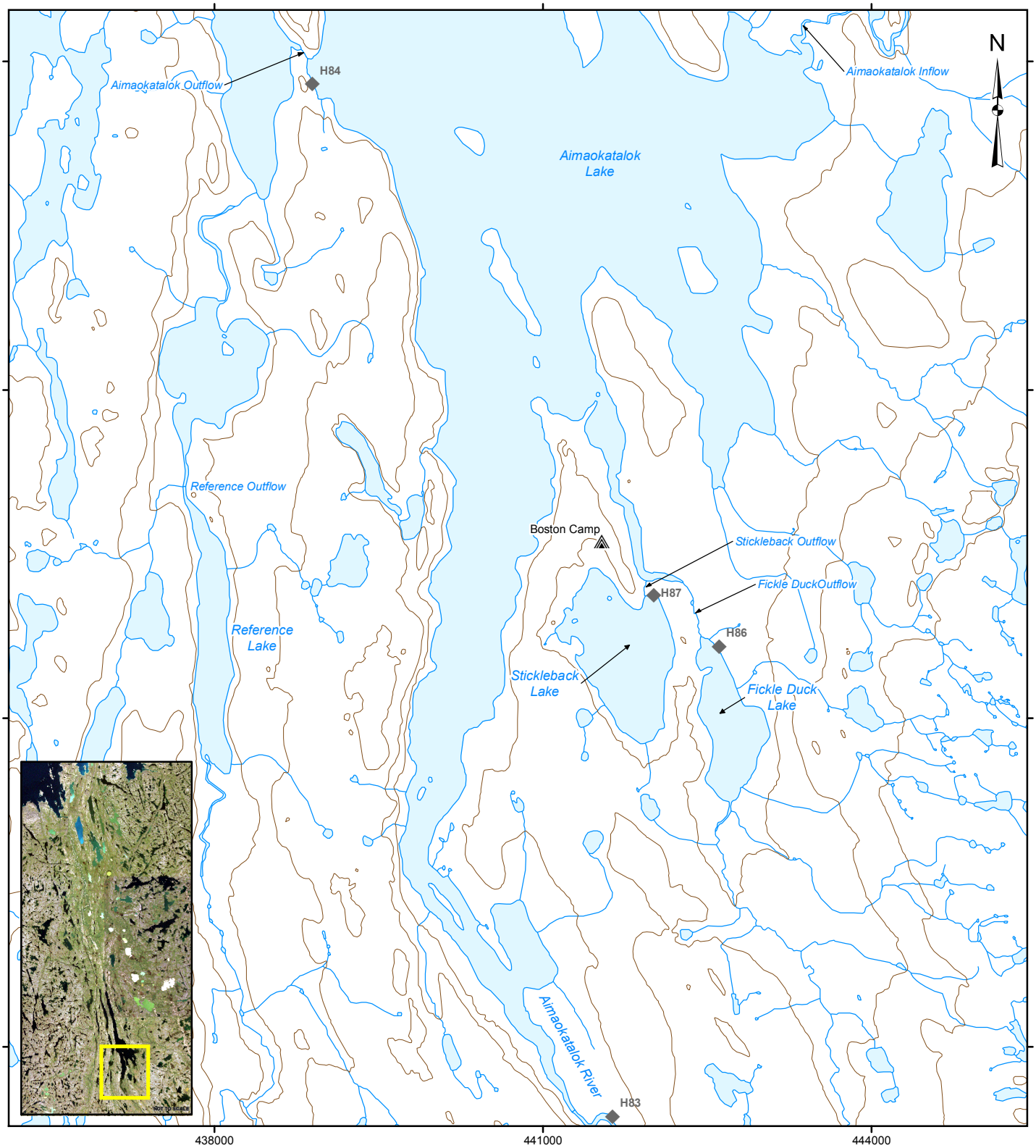
- Boston Project Area: H83 Aimaokatalok River, H84 Aimaokatalok Lake and Outflow, H85 Koignuk River, H86 Fickle Duck Lake and Outflow, and H87 Stickleback Lake and Outflow (five stations) (Figures 2.1 and 2.2);
- Doris Project Area: H71 Doris Outflow, H72 Roberts Lake and Outflow, H73 Little Roberts Outflow, H74 Doris Lake, H75 Tail Lake, and H76 Tail Outflow (six stations) (Figure 2.2); and
- Madrid Project Area: H81 Patch Lake and Outflow, H82 Ogama Lake and Outflow, H89 P.O. Outflow, H90 P.O. Lake, H91 Wolverine Lake and Outflow, H92 Windy Lake and Outflow, and H93 Glenn Lake and Outflow (seven stations) (Figure 2.2).

At three of these stations (H74 Doris Lake, H75 Tail Lake, and H84 Aimaokatalok Lake and Outflow), the transducers and data loggers were left in place to collect data for the 2007 - 2008 winter, and they currently remain in place to collect data for the 2008 - 2009 winter.

At each hydrometric station, a Pressure Systems KPSI 730-series solid-state pressure transducer or a Keller Acculevel pressure transducer (0.10% static accuracy) and Optimum Instruments DD-320 data logger were installed under late winter ice conditions. This was timed to prevent refreezing and the associated potential transducer damage. Each data logger was programmed to record water pressure measurements at 15-minute intervals. Each station was referenced to an elevation benchmark.

Staff gauges were installed at the following hydrometric stations: H71 Doris Outflow, H72 Roberts Lake and Outflow, H73 Little Roberts Outflow, H76 Tail Outflow, H81 Patch Lake and Outflow, H85 Koignuk River, H92 Windy Lake and Outflow, H93 Glenn Lake and Outflow, and H83 Aimaokatalok River. This was done by driving 1.8 m long sections of T-bar into the lake bed or river bed to a depth of approximately 0.5 m and attaching an aluminum metre stick to measure the variations in the water level.

Discharge measurements for three hydrometric stations (H83 Aimaokatalok River, H84 Aimaokatalok Lake and Outflow, and H85 Koignuk River) during high water were performed using the RDI Teledyne Workhorse Rio Grande Acoustic Doppler Current Profiler (ADCP) instrument. The ADCP instrument is an accurate, rapid-sampling current profiling system designed to operate from a moving platform (e.g., manned boat, tethered boat) that allows collection of real-time discharge measurements for cross-sections where wading is not possible.




**LEGEND**

- CAMP
- HYDROMETRIC STATION
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 HYDROMETRIC STATION LOCATIONS BOSTON PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 0 |
|---|---|---|---|---|
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| GIS | RC | 9 Jan. 2009 | | |
| CHECK | AH | 9 Jan. 2009 | | |
| REVIEW | NS | 9 Jan. 2009 | | |

**FIGURE: 2.1**

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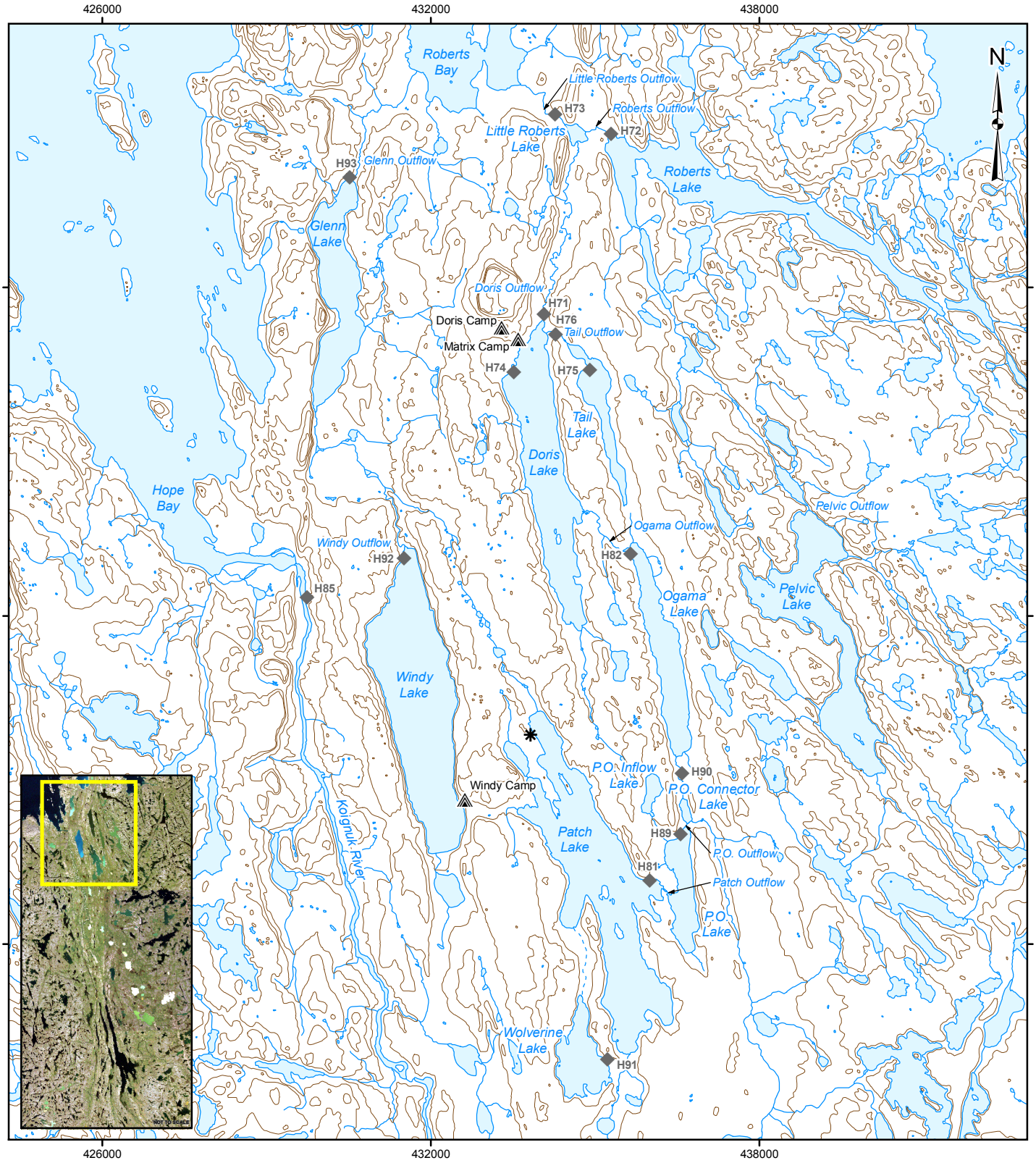


**LEGEND**

- HYDROMETRIC STATION
- CAMP
- MAJOR DRILLING SHOP
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

3000 0 3000

SCALE 1:100000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 HYDROMETRIC STATION LOCATIONS DORIS AND MADRID PROJECT AREAS**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 0 |
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| GIS | RC | 9 Jan. 2009 | | |
| CHECK | AH | 9 Jan. 2009 | | |
| REVIEW | NS | 9 Jan. 2009 | | |

**FIGURE: 2.2**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig2_2_AQ_SL_Hydrometric_Madrid08_09Jan2009.mxd

During visits to stations with flowing water where wading was possible, stream discharge measurements were performed according to the Water Survey of Canada standard described by Terzl et al. (1994).

For all stations, water depth data were downloaded periodically and generally concurrent with discharge measurements. During selected data logger downloads, water surface elevations were surveyed from the permanent benchmark and pressure transducer and staff gauge readings were recorded.

During the last visit of 2008, the pressure transducer and data logger were removed from each hydrometric station to prevent ice damage over the winter. The exceptions were at H74 Doris Lake, H75 Tail Lake, and H84 Aimaokatalok Lake and Outflow where water depths are great enough to allow the measurement devices to be left in place over winter.

For the Doris Project Area, the hydrology program started between 19 and 22 June 2008, when pressure transducers and data loggers were installed; the annual peak flow occurred after the installation of the transducers and it was recorded. For the Madrid Project Area, the hydrology program started between 18 and 23 June 2008; this period appears to be the peak flow time for most of the stations. For the Boston Project Area, the hydrology program started between 24 and 26 June 2008; the peak flow period was not recorded. According to the H84 Aimaokatalok Lake and Outflow transducer that remained in place over the winter, the peak flow occurred on 23 June 2008.

The transducer at the H92 Windy Lake and Outflow station malfunctioned at the beginning of the open water program, and it was replaced during the next field visit on 2 July 2008. Continuous data are not available before that date.

The transducer at the H82 Ogama Lake and Outflow station malfunctioned at the beginning of the open water program, and it was replaced during the next field visit on 2 July 2008. Continuous data are not available before that date and the discharge hydrograph between the first and the second visit was derived by interpolation between the first discharge measurement and the first value of the continuous hydrograph.

The datalogger at the H86 Fickle Duck Lake and Outflow station was installed under snow conditions. However, the subsequent rise in lake water level submerged the data logger and data are unavailable for the first part of the season. During the field visit of 11 August 2008, the data logger was replaced, a tripod was constructed and the datalogger case was placed above the flood level.

When all data were available for flowing water stations, the record of water surface elevation versus discharge was used to establish a stage-discharge rating curve for each station, considering data from previous years. This rating curve was then applied to the continuous record of water surface elevations to derive a continuous record of discharges. For some stations, limited stage-discharge data were available, so a continuous discharge hydrograph for the entire season was not derived. For some stations where continuous recordings were not available, mean daily discharge values were estimated by interpolating between manual discharge measurements.

## 2.2.2 Snow Course Surveys

Late winter measurements of snow depths, snow densities, and snow water equivalents were performed to characterize the amount of snow available to contribute to spring runoff, over a range of terrain types. Snow course surveys were undertaken from 16 to 21 May 2008 using the following methods:

### *Plot Selection*

Plot locations within the Doris and Boston Project Areas were selected and sampled based on the terrain type. These included the following:

- Open lake (flat areas on lakes);
- Exposed lowland (flat areas at the top of slopes);
- Sheltered lowland (flat areas at the toe of slopes); and
- North, east, south, and west aspects (slopes facing these directions).

This was done to identify differences in snow accumulation between terrain types. Plot locations in 2008 were at sites sampled in previous years (2006 to 2007 for the Boston Project Area and 2004 to 2007 for the Doris Project Area).

### *Snow Depth Measurement*

At each plot, 30 depth measurements were taken at locations randomly selected from within a large circle, with approximately 10 m between measurements. Depth was measured by inserting a metre stick into the snowpack and reading the snowline mark.

### *Snow Density Measurement*

Three density measurements were recorded at each plot using a snow density sampler. The sampler was carefully inserted to avoid compacting the snowpack.

Snow depth was recorded when the corer reached the soil surface. The corer was then pushed farther into the ground to ensure that a plug of soil was extracted with the sampler to prevent granular snow from falling out. After extracting the sampler and carefully removing the soil plug, the snow mass was measured by calculating the difference between the sampler weight with and without the snow core. These measurements were later used to calculate the snow water equivalent of the sample.

### 2.2.3 Rainfall

Rainfall monitoring was performed to characterize the amount of rain that contributed to runoff during the open water season. Two weather stations were in operation in the Project Area. One was located approximately 300 m northwest from Doris Lake and collects data for the Doris Project Area. The second weather station was located in the Boston Project Area, on the south side of the Boston Camp. The sensors installed at these stations measure the following parameters:

- Air temperature (hourly mean, maximum, and minimum);
- Relative humidity (hourly maximum and minimum);
- Vapour pressure (hourly mean, maximum, and minimum);
- Global solar radiation (hourly mean and total);
- Wind speed and direction (value and time of hourly maximum, mean horizontal wind speed, unit vector of mean wind direction, and standard deviation of wind direction for each hour); and
- Rainfall (hourly accumulated depth).

Rainfall at these stations was recorded using a tipping bucket rain gauge, and the rainfall record was used to derive total daily and monthly rainfall during the summer months. For the Boston weather station, the rainfall data from 2008 are not included because of equipment malfunction.

## 2.3 BOSTON PROJECT HYDROMETRY

### 2.3.1 H83 Aimaokatalok River

A factsheet describing the location of the hydrometric station and equipment installed at H83 Aimaokatalok River is provided in Appendix A1. The appendix also contains stage-discharge data collected in 2008, the derived stage-discharge rating curve based on data collected between 2006 and 2008, derived mean daily discharge and water level data from 2008, and manual discharge measurement

data and calculation sheets from 2008. Discharge data sheets from measurements done with the ADCP in 2008 are provided in Appendix A4.

The H83 Aimaokatalok River hydrometric station was visited four times (Table 2.1) during the 2008 field program, and the data collected were used to derive a continuous hydrograph for the period of 24 June to 11 September 2008 (Figure 2.3).

**Table 2.1 Site Visits to H83 Aimaokatalok River Hydrometric Station, 2008**

| Date (2008) | Activities | River | Water Level (non-geodetic) | Discharge |
|---|---|---|---|---|
| 24 Jun | Installed pressure transducer and datalogger. | | | |
| 6 Jul | Measured water surface elevation and discharge (ADCP) and downloaded data logger. | ✓ | 98.282 m | 16.90 $m^3/s$ |
| 11 Aug | Measured water surface elevation and discharge (manual) and downloaded data logger. | ✓ | 98.027 m | 7.37 $m^3/s$ |
| 11 Sep | Measured discharge (manual) and water surface elevation, downloaded and removed data logger for winter. | ✓ | 98.309 m | 14.31 $m^3/s$ |

Prepared by: DC Checked by: ZC

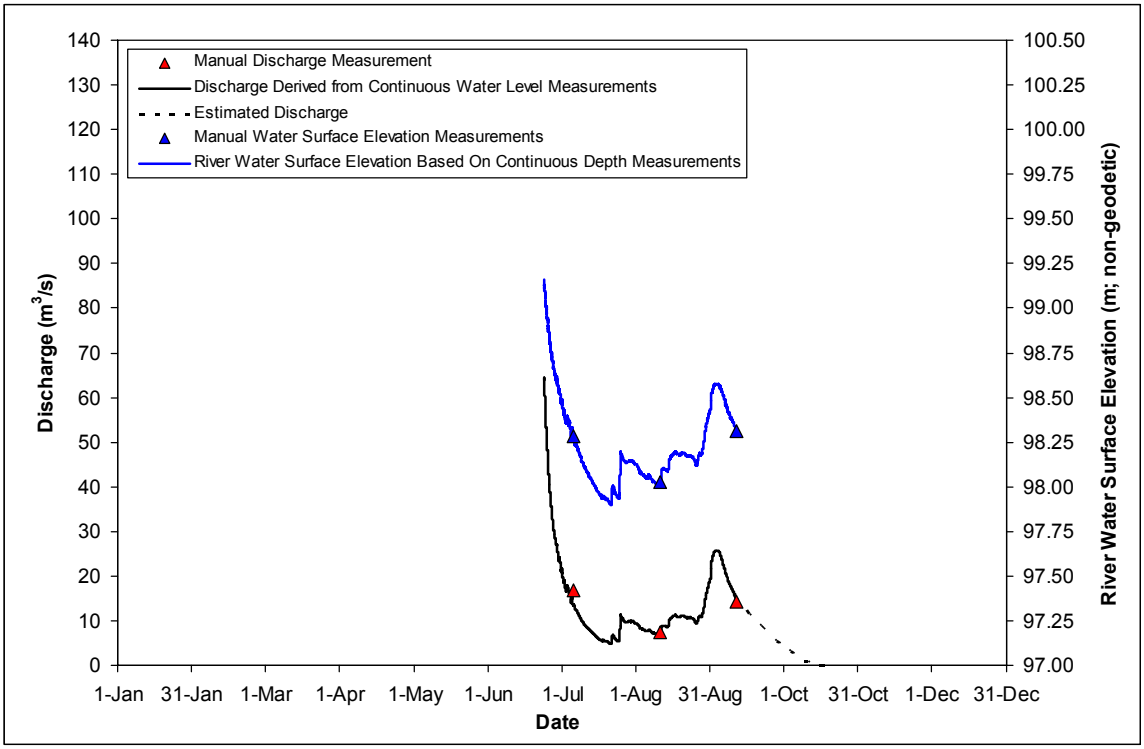



**Figure 2.3 Hydrograph for H83 Aimaokatalok River, June to September 2008**

Continuous water level data from 24 June to 11 September 2008 were recorded. A discharge measurement could not be done during the first visit because of high water levels. The stage-discharge rating curve would benefit from more measurements performed during high water at the beginning of the open water season, using an ADCP, to better describe spring flood conditions. Discharges between 12 September and 17 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

### 2.3.2 H84 Aimaokatalok Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H84 Aimaokatalok Lake and Outflow is provided in Appendix A1. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2007 and 2008. Discharge data sheets from measurements done with the ADCP in 2008 are provided in Appendix A4. The 2007 hydrograph for this station, including late season records of water level and discharge data collected after the 2007 field season that were not presented in the 2007 report is shown in Figure 2.4.

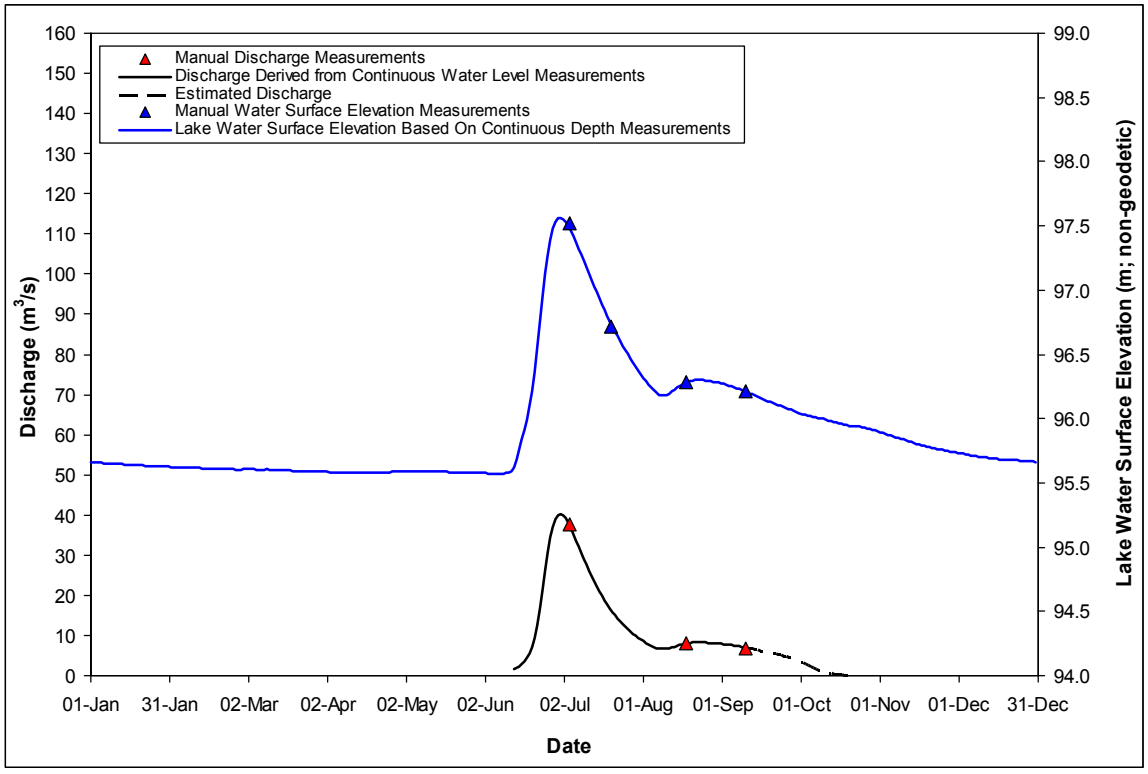



**Figure 2.4 Hydrograph for H84 Aimaokatalok Lake and Outflow, 2007**

The H84 Aimaokatalok Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.2), and a continuous hydrograph was derived for the period 1 January to 11 September 2008 (Figure 2.5) based on continuous logger data. The data logger and the transducer were left in place to monitor the water levels during winter season.

**Table 2.2 Site Visits to H84 Aimaokatalok Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 24 Jun | Replaced the over-winter data logger and measured water surface elevation. | ✓ | 98.812 m | | |
| 6 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 97.853 m | ✓ | 48.0 $m^3/s$ |
| 13 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 97.653 m | ✓ | 16.2 $m^3/s$ |
| 11 Sep | Measured discharge and water surface elevation, downloaded data logger. | ✓ | 97.289 m | ✓ | 30.8 $m^3/s$ |

Prepared by: DC Checked by: ZC

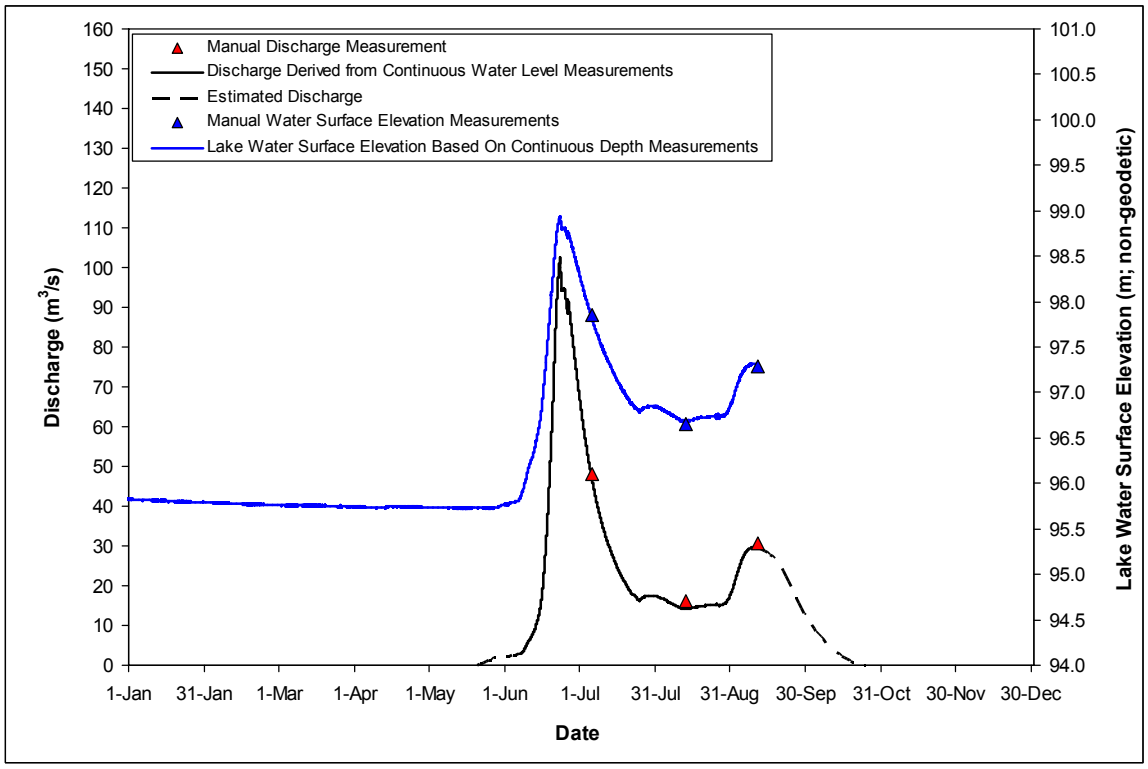



**Figure 2.5 Hydrograph for H84 Aimaokatalok Lake and Outflow, January to October 2008**

The field data indicate that the water levels at H84 Aimaokatalok Lake increased by approximately 3 m during spring runoff. The data logger at the station functioned over the winter of 2007 to 2008. When the station was first visited in 2008 on 24 June, the data logger was found flooded and it was replaced with a spare. The data collected over the entire winter season were not affected and a continuous record was obtained.

Discharges between 22 May and 6 June 2008 were estimated based on measured lake water surface elevations, and discharges between 12 September and 23 October 2008 were estimated based on recession to the estimated freeze-up date.

### 2.3.3 H86 Fickle Duck Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H86 Fickle Duck Lake and Outflow is provided in Appendix A1. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H86 Fickle Duck Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.3). A continuous hydrograph was generated for the period of 11 August to 11 September 2008 (Figure 2.6). For the first part of the season, before 11 August, the rise in lake water level flooded the data logger and no data could be retrieved. Discharges between 12 September and 9 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.3 Site Visits to H86 Fickle Duck Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 26 Jun | Installed pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 98.922 m | ✓ | 0.996 $m^3/s$ |
| 5 Jul | Measured water surface elevation and discharge and replaced data logger. | ✓ | 98.841 m | ✓ | 0.383 $m^3/s$ |
| 11 Aug | Measured water surface elevation and discharge and replaced data logger. | ✓ | 98.864 m | ✓ | 0.393 $m^3/s$ |
| 11 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 98.916 m | ✓ | 0.484 $m^3/s$ |

Prepared by: DC Checked by: ZC

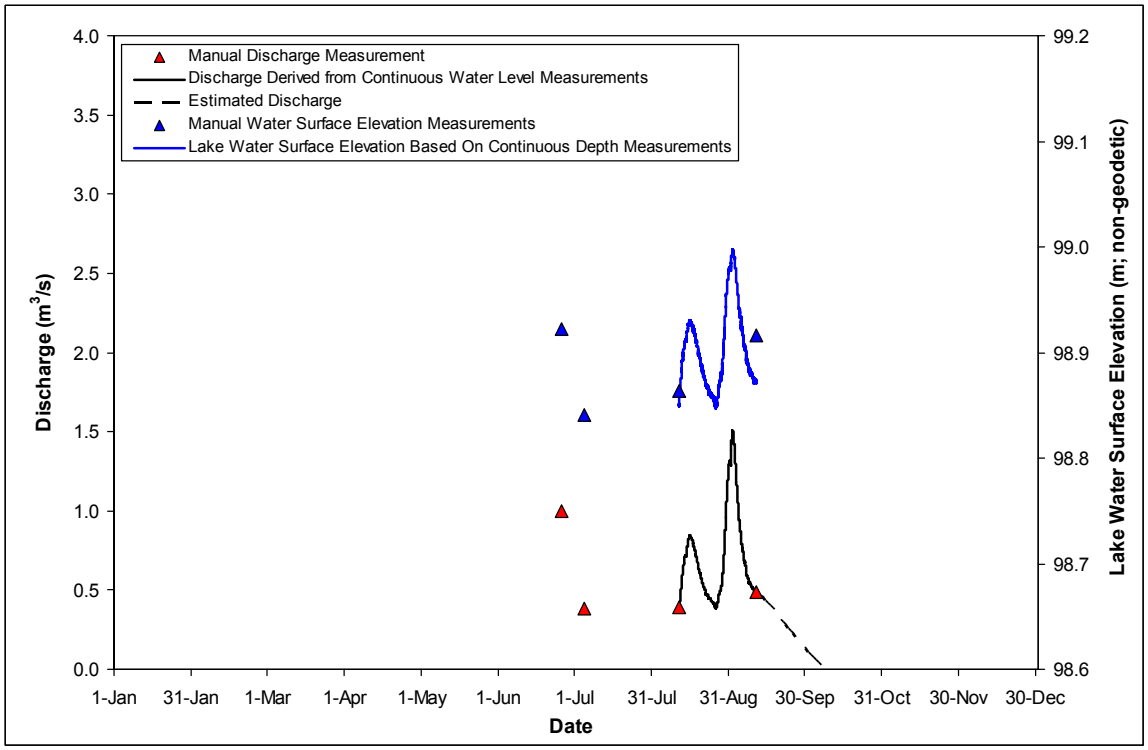



**Figure 2.6 Hydrograph for H86 Fickle Duck Lake and Outflow, June to September 2008**

## 2.3.4 H85 Koignuk River

A factsheet describing the location of the hydrometric station and equipment installed at H85 Koignuk River is provided in Appendix A1. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, and mean daily discharge and water level data from 2008. Discharge data sheets from measurements done with the ADCP in 2008 are provided in Appendix A4.

The H85 Koignuk River hydrometric station was visited four times during the 2008 field program (Table 2.4). A continuous hydrograph was generated for the period from 23 June to 14 September 2008 (Figure 2.7).

**Table 2.4 Site Visits to H85 Koignuk River Hydrometric Station, 2008**

| Date (2008) | Activities | River | Water Level (non-geodetic) | Discharge |
|---|---|---|---|---|
| 23 Jun | Installed pressure transducer and datalogger and measured water surface elevation. | ✓ | 99.484 m | |
| 6 Jul | Measured discharge and downloaded data logger. | ✓ | | 98.7 $m^3/s$ |
| 11 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 97.351 m | 29.1 $m^3/s$ |
| 14 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 97.802 m | 53.9 $m^3/s$ |

Prepared by: DC Checked by: ZC

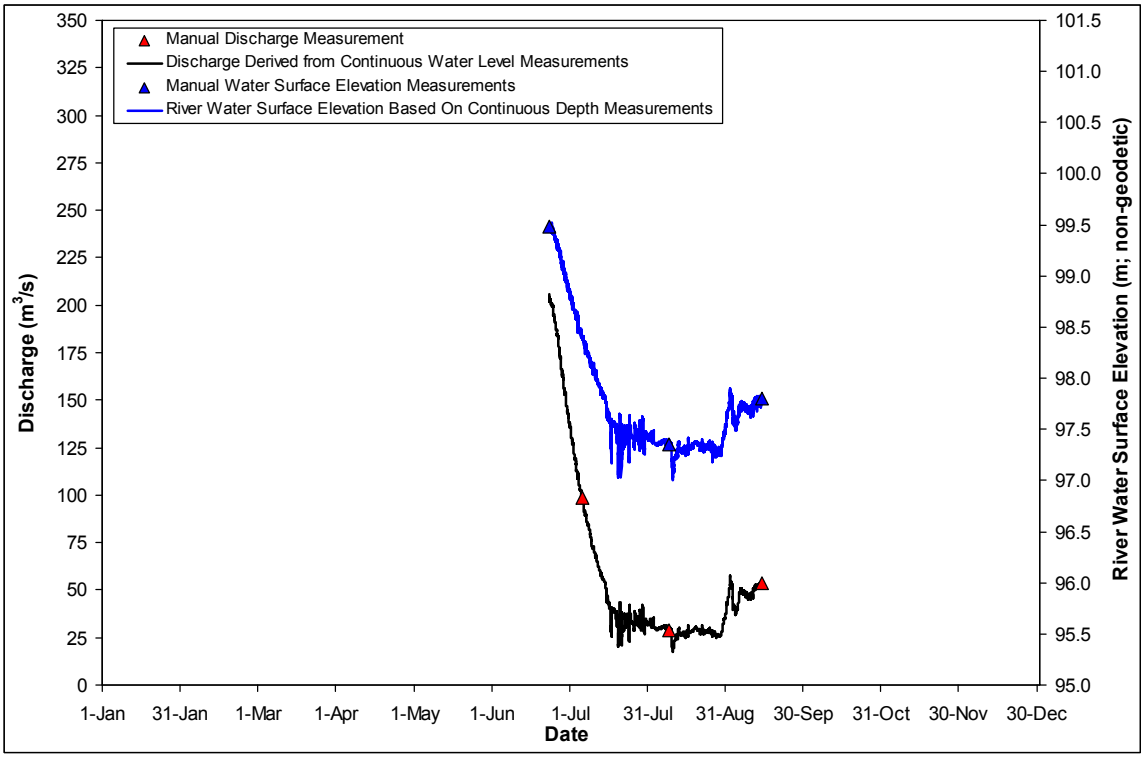



**Figure 2.7 Hydrograph for H85 Koignuk River, June to September 2008**

## 2.3.5 H87 Stickleback Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H87 Stickleback Lake and Outflow is provided in Appendix A1. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008; mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H87 Stickleback Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.5). Data were used to generate a continuous hydrograph for the period 26 June to 11 September 2008 (Figure 2.8). Discharges between 12 and 24 September 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.5 Site Visits to H87 Stickleback Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 26 Jun | Installed staff gauge, pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 98.836 m | ✓ | 0.093 $m^3/s$ |
| 5 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.764 m | ✓ | 0.054 $m^3/s$ |
| 11 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.770 m | ✓ | 0.044 $m^3/s$ |
| 11 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter | ✓ | 98.827 m | ✓ | 0.071 $m^3/s$ |

Prepared by: DC Checked by: ZC

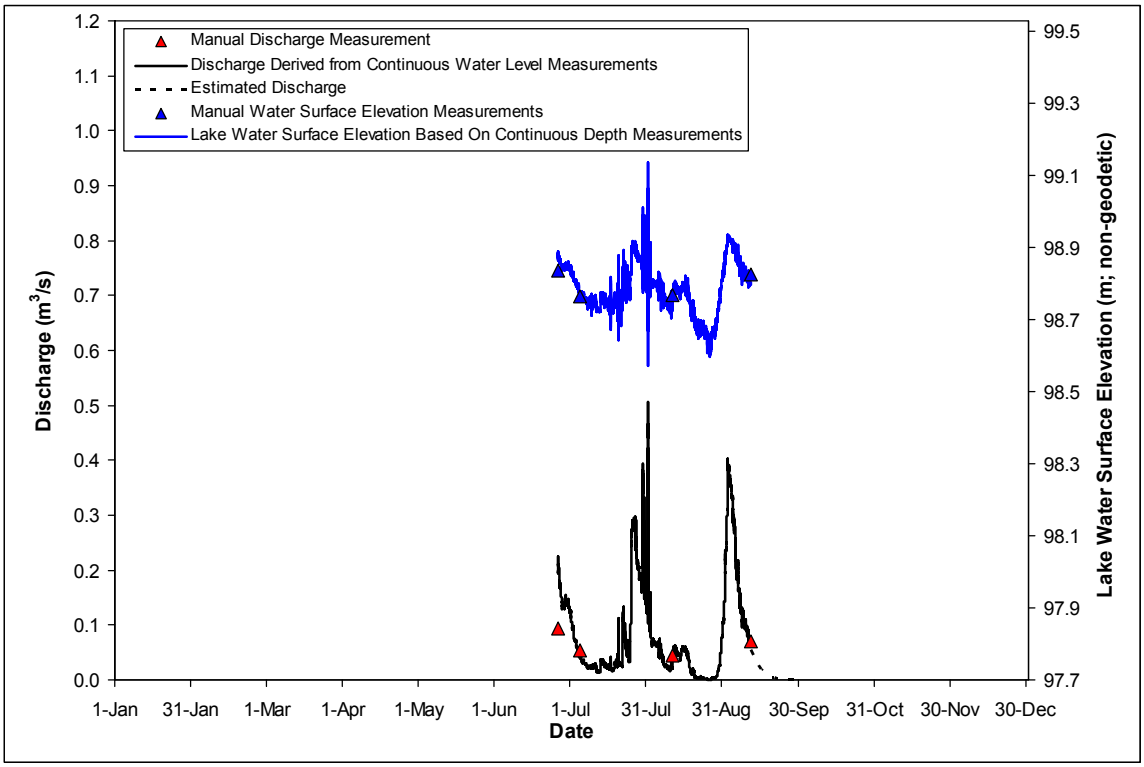



**Figure 2.8 Hydrographs for H87 Stickleback Lake and Outflow, June to September 2008**

# 2.4 DORIS PROJECT HYDROMETRY

## 2.4.1 H71 Doris Outflow and H74 Doris Lake

Factsheets describing the locations of the hydrometric stations and equipment installed at H74 Doris Lake and H71 Doris Outflow are provided in Appendix A2. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2003 to 2008, tabulated mean daily discharge and water level data from 2007 and 2008, manual discharge measurement data and calculation sheets from 2008.

The H71 Doris Outflow hydrometric station was visited four times during the 2008 field program (Table 2.6), and a continuous hydrograph was derived for the period 22 June to 12 September 2008 (Figure 2.9). Discharges between 2 June and 21 June 2008 were estimated based on the measured upstream lake water surface elevation, and discharges between 13 September and 13 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.6 Site Visits to H71 Doris Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Outflow | Water Level (geodetic) | Discharge |
|---|---|---|---|---|
| 22 Jun | Installed staff gauge, pressure transducer, and datalogger, measured discharge and water surface elevation. | ✓ | 21.860 m | 4.78 $m^3/s$ |
| 1 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 21.765 m | 3.12 $m^3/s$ |
| 9 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 21.445 m | 0.808 $m^3/s$ |
| 12 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 21.517 m | 1.34 $m^3/s$ |

Prepared by: DC Checked by: ZC

The H74 Doris Lake hydrometric station was visited three times during the 2008 field program (Table 2.7), and a continuous hydrograph was derived for the period 1 January to 12 September 2008, based on continuous logger data.

The Doris Lake hydrometric station has a thermistor installed at the pressure transducer, which records water temperatures throughout the entire year. The 2007 lake hydrograph, including late season records of water level and temperatures data collected after the 2007 field season that were not presented in

the 2007 report, is shown in Figure 2.10. The hydrograph for Doris Lake in 2008 is presented in Figure 2.11 with the record of temperatures recorded at the transducer.

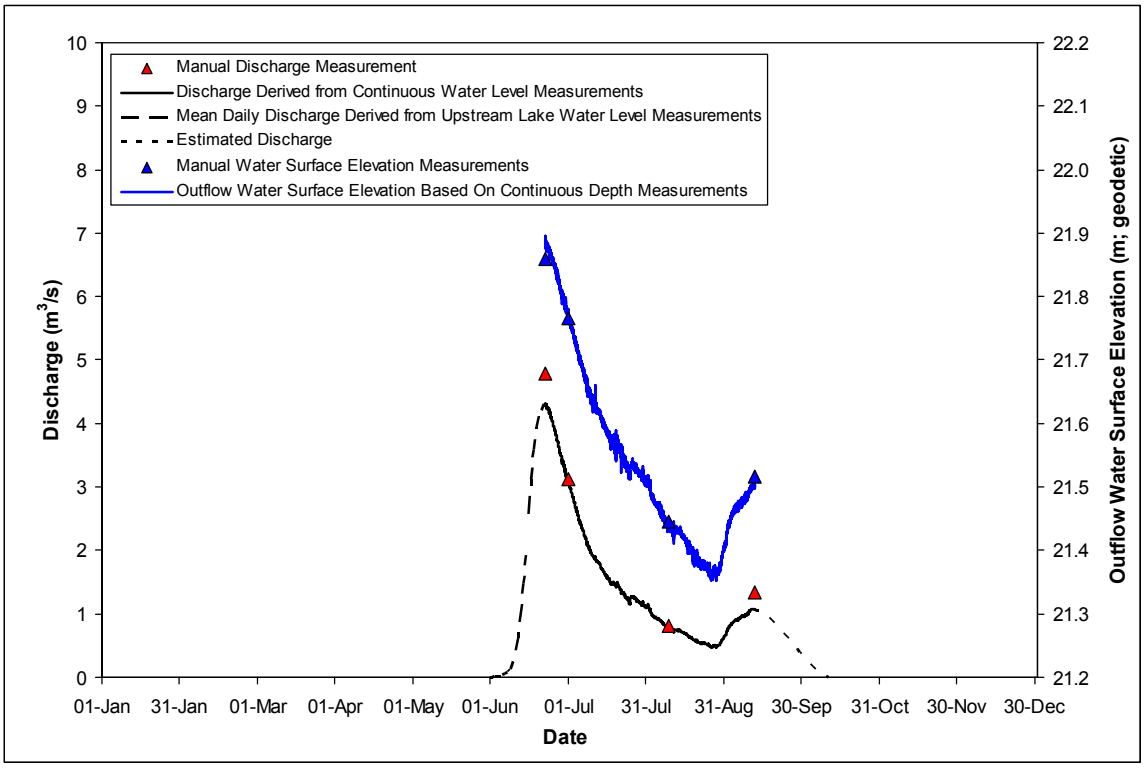



**Figure 2.9 Hydrograph for H71 Doris Outflow, June to September 2008**

**Table 2.7 Site Visits to H74 Doris Lake Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (geodetic) |
|---|---|---|---|
| 1 Jul | Measured water surface elevation and downloaded data logger. | ✓ | 21.983 m |
| 14 Aug | Measured water surface elevation and downloaded data logger. | ✓ | 21.619 m |
| 12 Sep | Measured water surface elevation and downloaded data logger. | ✓ | 21.704 m |

Prepared by: DC Checked by: ZC

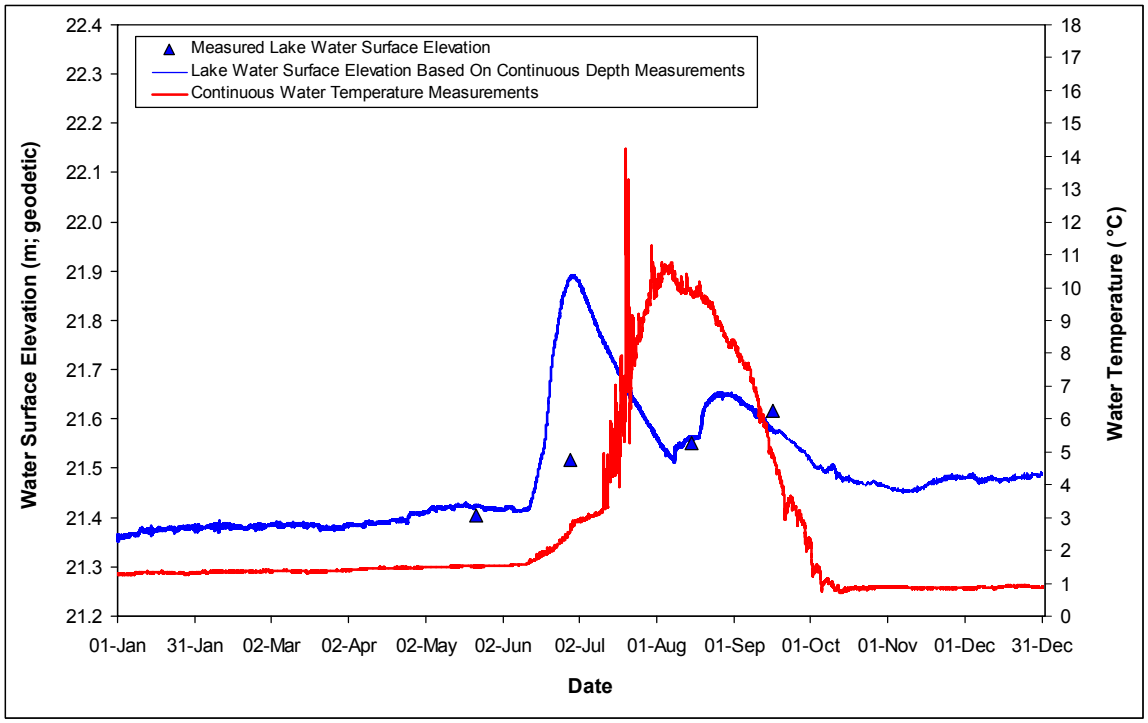



**Figure 2.10 Hydrograph and Water Temperatures for H74 Doris Lake, 2007**

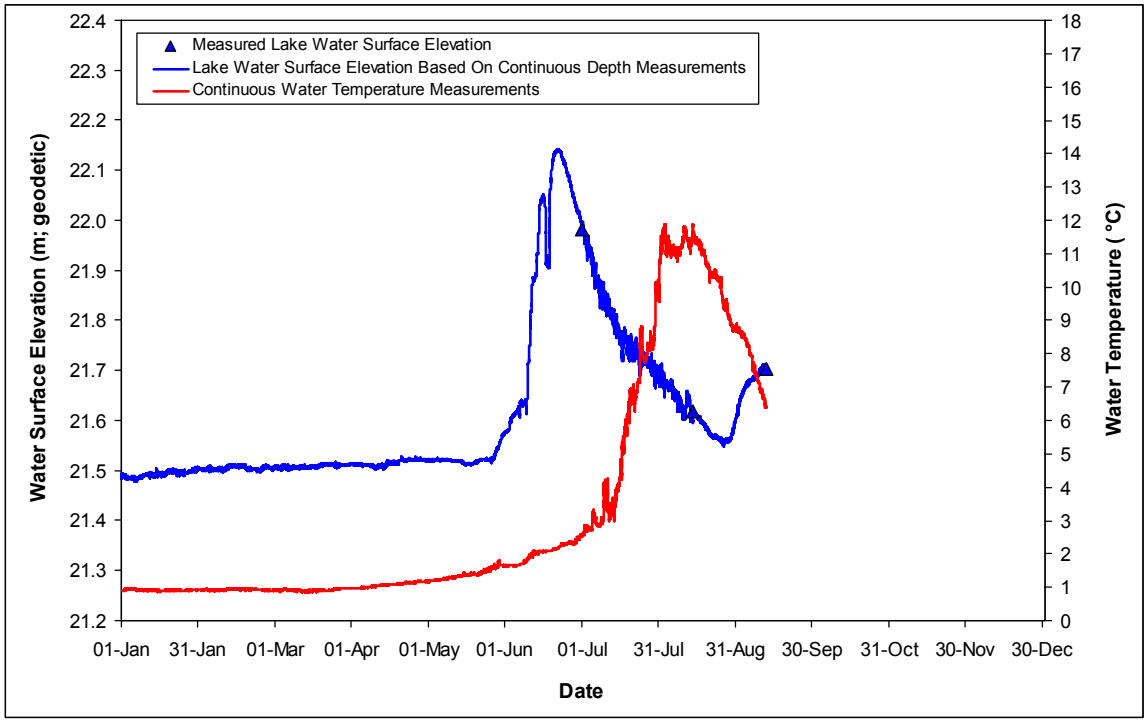



**Figure 2.11 Hydrograph and Water Temperatures for H74 Doris Lake, January to September 2008**

## 2.4.2 H75 Tail Lake and H76 Tail Outflow

Factsheets describing the locations of the hydrometric stations and equipment installed at H75 Tail Lake and H76 Tail Outflow are provided in Appendix A2. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2004 to 2008, tabulated mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H75 Tail Lake hydrometric station was visited three times during the 2008 field program (Table 2.8).

**Table 2.8 Site Visits to H75 Tail Lake Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (geodetic) |
|---|---|---|---|
| 1 Jul | Measured water surface elevation and downloaded data logger. | ✓ | 28.353 m |
| 9 Aug | Measured water surface elevation and downloaded data logger. | ✓ | 28.232 m |
| 12 Sep | Measured water surface elevation and downloaded data logger. | ✓ | 28.274 m |

Prepared by: DC Checked by: ZC

The 2007 lake hydrograph, including late season records of water level and temperature data collected after the 2007 field season that were not presented in the previous report, is shown in Figure 2.12. A continuous hydrograph was derived for the period from 1 January to 12 September 2008 (Figure 2.13).

The Tail Lake hydrometric station has a thermistor installed at the pressure transducer, which records water temperatures throughout the entire year. The record of temperatures for Tail Lake in 2007 and 2008 is also presented in Figure 2.12 and Figure 2.13.

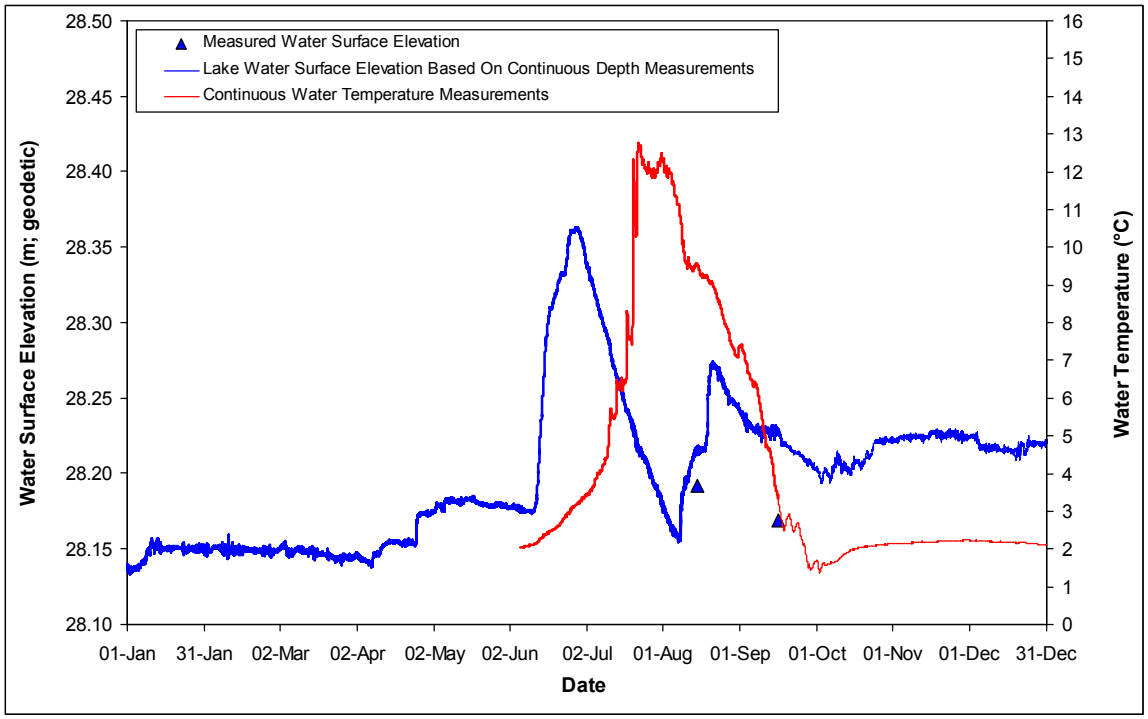



**Figure 2.12 Hydrograph and Water Temperature for H75 Tail Lake, 2007**

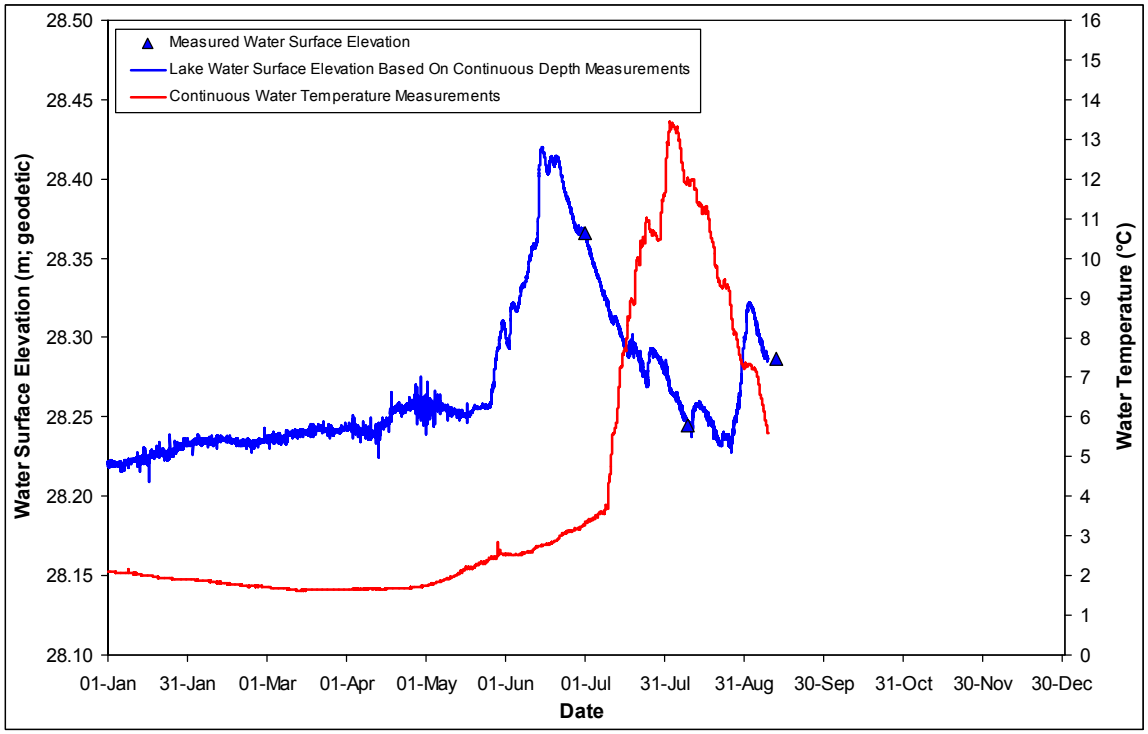



**Figure 2.13 Hydrograph and Water Temperatures for H75 Tail Lake, January to September 2008**

The H76 Tail Outflow hydrometric station was visited four times during the 2008 field program (Table 2.9), and a continuous hydrograph was derived for the period 3 June to 8 October 2008 (Figure 2.14). Discharges between 3 June and 22 June 2008 were estimated based on the measured upstream lake water surface elevations, and discharges between 12 September and 8 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.9 Site Visits to H76 Tail Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Outflow | Water Level (geodetic) | Discharge |
|---|---|---|---|---|
| 22 Jun | Installed staff gauge, pressure transducer, and datalogger, measured discharge and water surface elevation. | ✓ | 24.265 m | 0.153 $m^3/s$ |
| 1 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 24.255 m | 0.092 $m^3/s$ |
| 9 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 24.181 m | 0.022 $m^3/s$ |
| 12 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 24.191 m | 0.067 $m^3/s$ |

Prepared by: DC Checked by: ZC

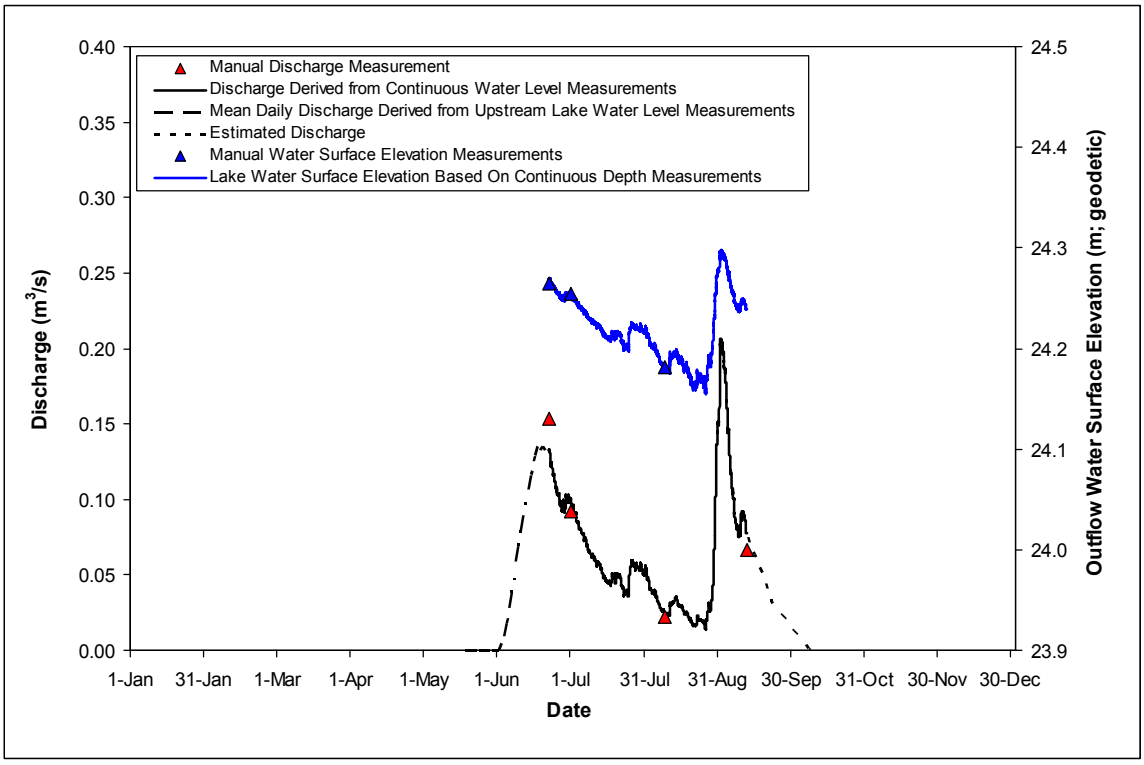



**Figure 2.14 Hydrograph for H76 Tail Outflow, June to September 2008**

### 2.4.3 H72 Roberts Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H72 Roberts Lake and Outflow is provided in Appendix A2. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2003 to 2008, tabulated mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H72 Roberts Lake and Roberts Outflow hydrometric station was visited four times during the 2008 field program (Table 2.10), and a continuous hydrograph was derived for the period 2 June to 8 October (Figure 2.15). Discharges between 12 September and 8 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.10 Site Visits to H72 Roberts Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 19 Jun | Installed staff gauge, pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 6.499 m | ✓ | 5.90 $m^3/s$ |
| 2 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 6.367 m | ✓ | 2.81 $m^3/s$ |
| 9 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 6.158 m | ✓ | 0.851 $m^3/s$ |
| 12 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 6.258 m | ✓ | 1.73 $m^3/s$ |

Prepared by: DC Checked by: ZC

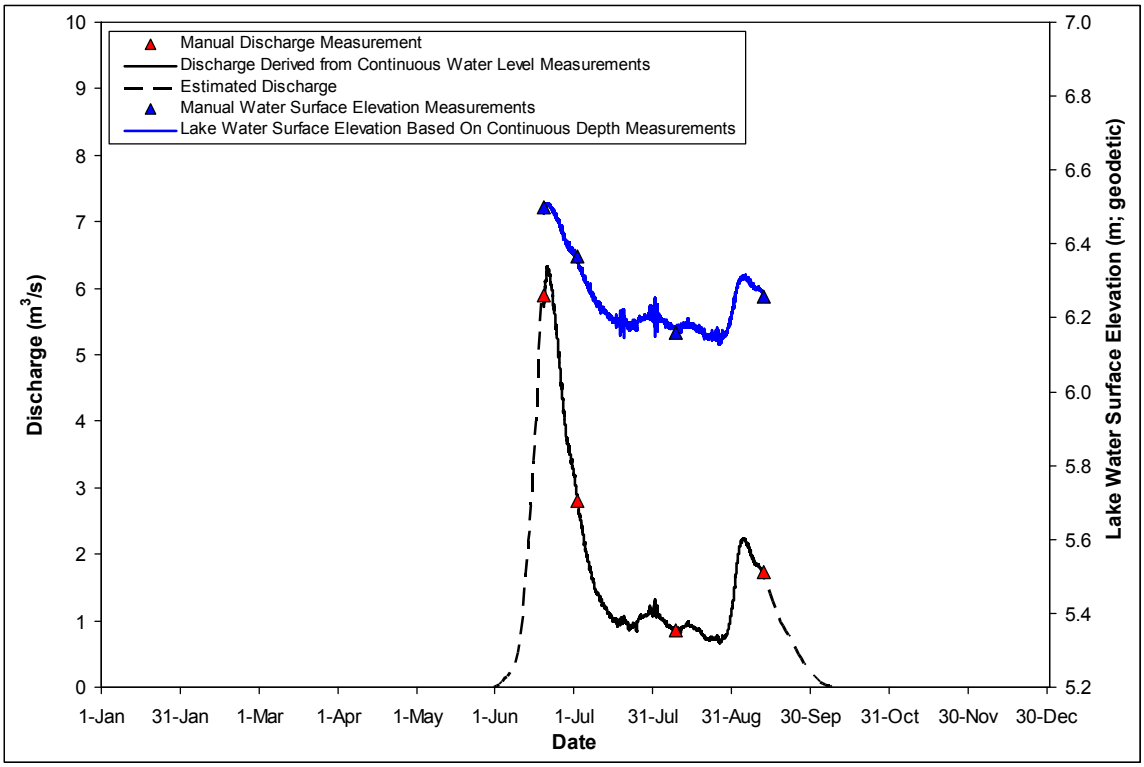



**Figure 2.15 Hydrograph for H72 Roberts Lake and Outflow, June to September 2008**

## 2.4.4 H73 Little Roberts Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H73 Little Roberts Outflow is provided in Appendix A2. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2003 to 2008, tabulated mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H73 Little Roberts Outflow hydrometric station was visited four times during the 2008 field program (Table 2.11), and a continuous hydrograph was derived for the period 30 May to 12 October (Figure 2.16). Discharges between 13 September and 12 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.11 Site Visits to H73 Little Roberts Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|
| 19 Jun | Installed staff gauge, pressure transducer and datalogger, measured water surface elevation. | 98.605 m | ✓ | |
| 1 Jul | Measured water surface elevation and discharge and downloaded data logger. | 98.352 m | ✓ | 5.69 $m^3/s$ |
| 9 Aug | Measured water surface elevation and discharge and downloaded data logger. | 98.051 m | ✓ | 1.36 $m^3/s$ |
| 12 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | 98.145 m | ✓ | 2.37 $m^3/s$ |

Prepared by: DC Checked by: ZC

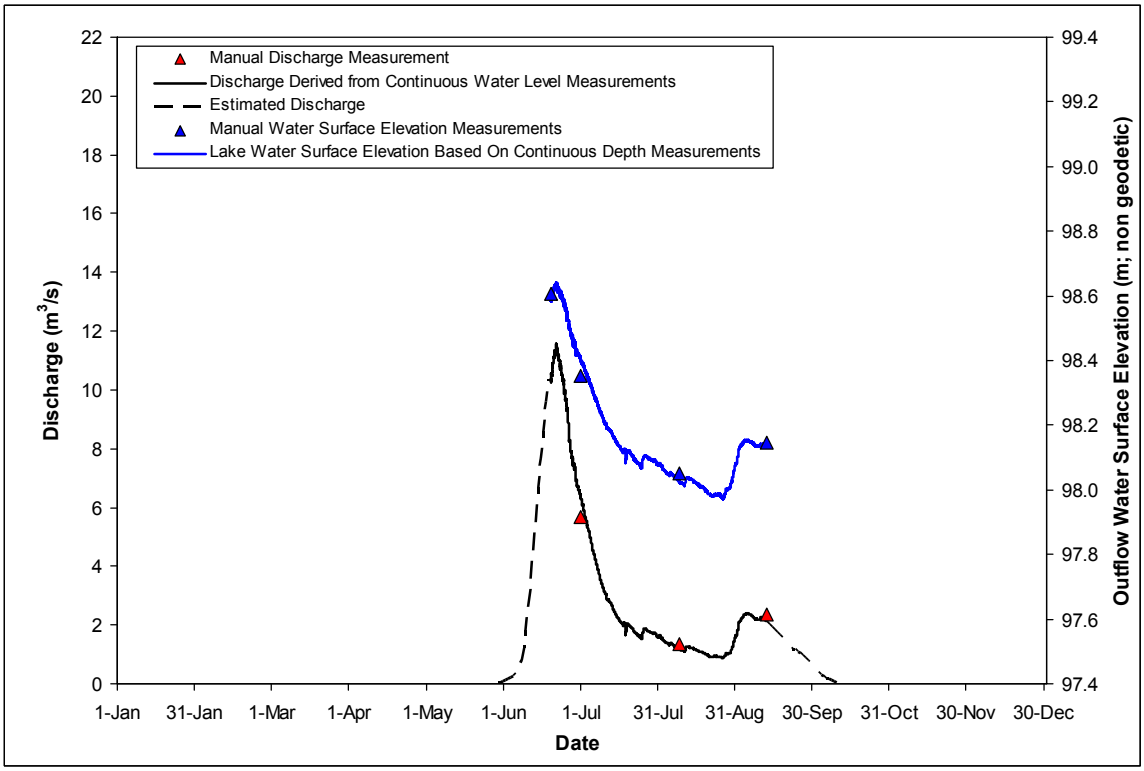



**Figure 2.16 Hydrograph for H73 Little Roberts Outflow, June to September 2008**

# 2.5 MADRID PROJECT HYDROMETRY

## 2.5.1 H93 Glenn Lake and Outflow

A factsheet describing the locations of the hydrometric station and equipment installed at H93 Glenn Lake and Outflow is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H93 Glenn Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.12). A continuous hydrograph was derived for 19 June to 8 October 2008 (Figure 2.17). Discharges between 10 September and 8 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.12 Site Visits to H93 Glenn Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 19 Jun | Installed staff gauge, pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 99.188 m | ✓ | 1.36 $m^3/s$ |
| 2 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.694 m | ✓ | 0.749 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.561 m | ✓ | 0.352 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 98.591 m | ✓ | 0.523 $m^3/s$ |

Prepared by: DC Checked by: ZC

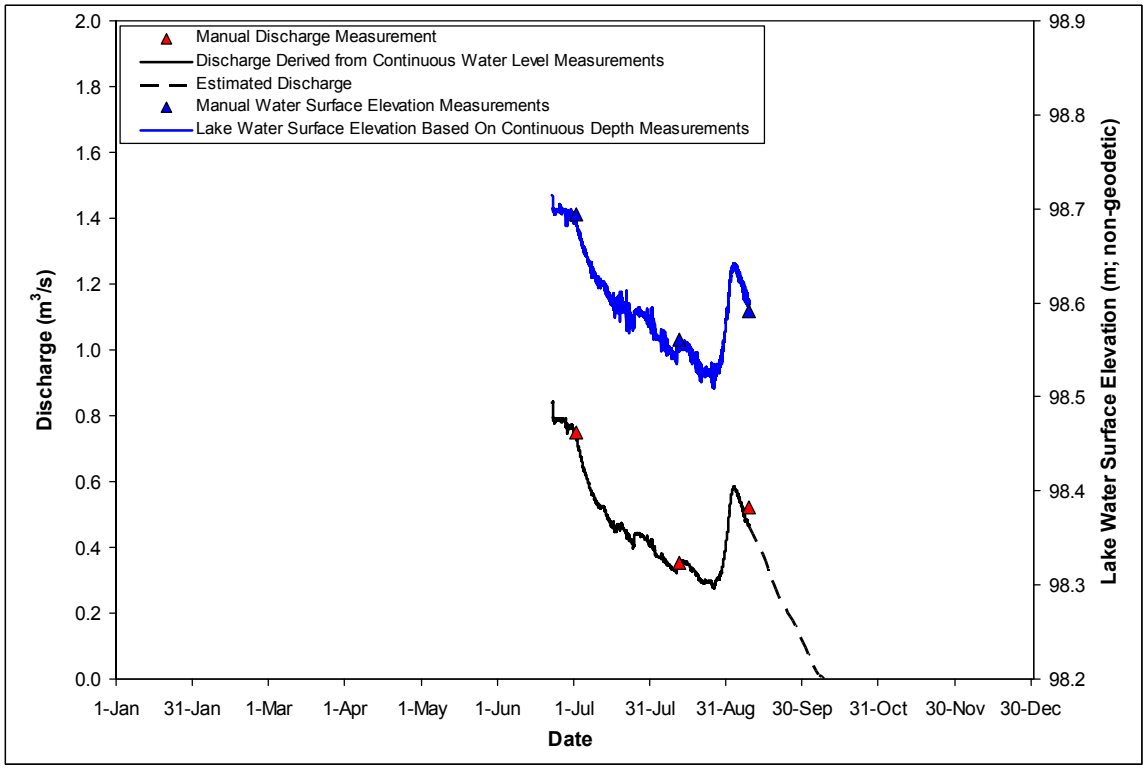



**Figure 2.17 Hydrograph for H93 Glenn Lake and Outflow, June to September 2008**

## 2.5.2 H82 Ogama Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H82 Ogama Lake and Outflow (Station H82) is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H82 Ogama Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.13). A continuous hydrograph was derived from data collected from 23 June to 10 October 2008 (Figure 2.18). During the 2 July 2008 visit, the transducer's readings were found to be out of range and a new transducer was installed. Because of that, the discharges between 23 June and 2 July 2008 were estimated based on interpolation between the first discharge measurement on 23 June and the first logged value on 2 July 2008. Discharges between 10 September and 10 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.13 Site Visits to H82 Ogama Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 23 Jun | Installed pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 98.778 m | ✓ | 3.41 $m^3/s$ |
| 2 Jul | Measured water surface elevation and discharge and replaced transducer and downloaded data logger. | ✓ | 98.638 m | ✓ | 2.26 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.367 m | ✓ | 0.505 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 98.514 m | ✓ | 1.05 $m^3/s$ |

Prepared by: DC Checked by: ZC

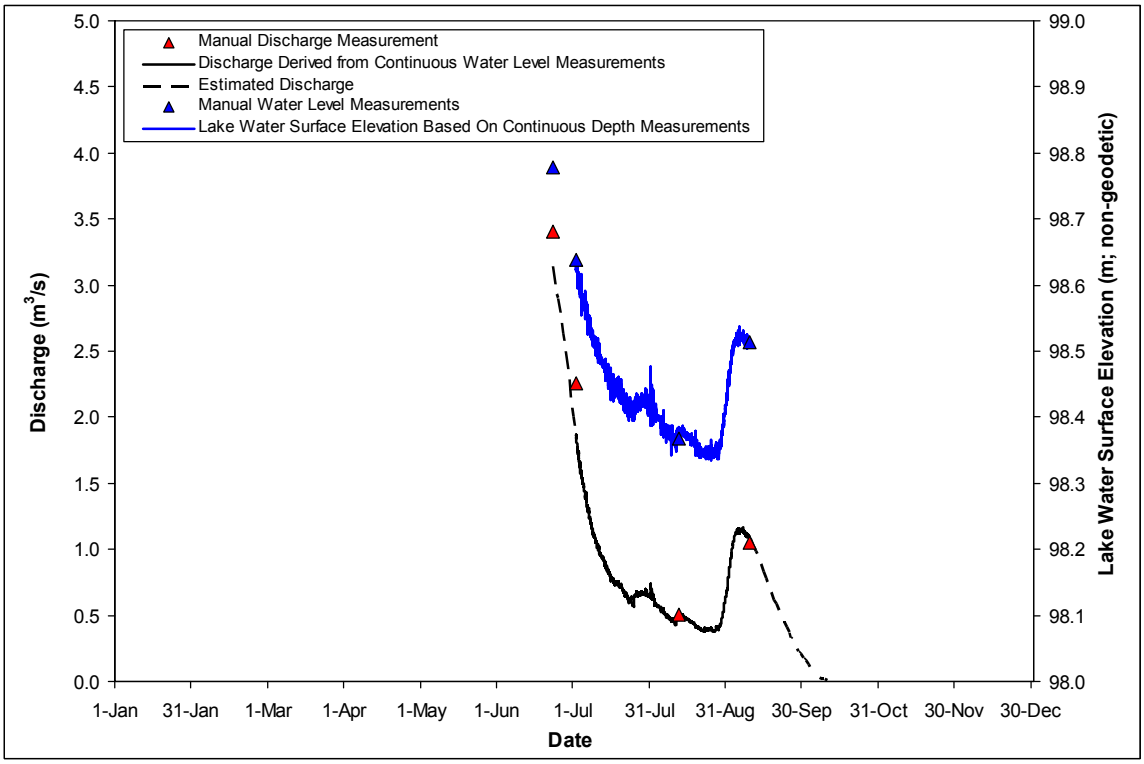



**Figure 2.18 Hydrograph for H82 Ogama Lake and Outflow, June to September 2008**

### 2.5.3 H81 Patch Lake and Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H81 Patch Lake and Outflow is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The H81 Patch Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.14). Resulting data were used to generate a continuous hydrograph for the period of 21 June to 8 October 2008 (Figure 2.19). Discharges between 10 September and 8 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.14 Site Visits to H81 Patch Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 21 Jun | Installed staff gauge, pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 99.239 m | ✓ | 1.39 $m^3/s$ |
| 1 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 99.144 m | ✓ | 0.882 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.994 m | ✓ | 0.310 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 99.035 m | ✓ | 0.348 $m^3/s$ |

Prepared by: DC Checked by: ZC

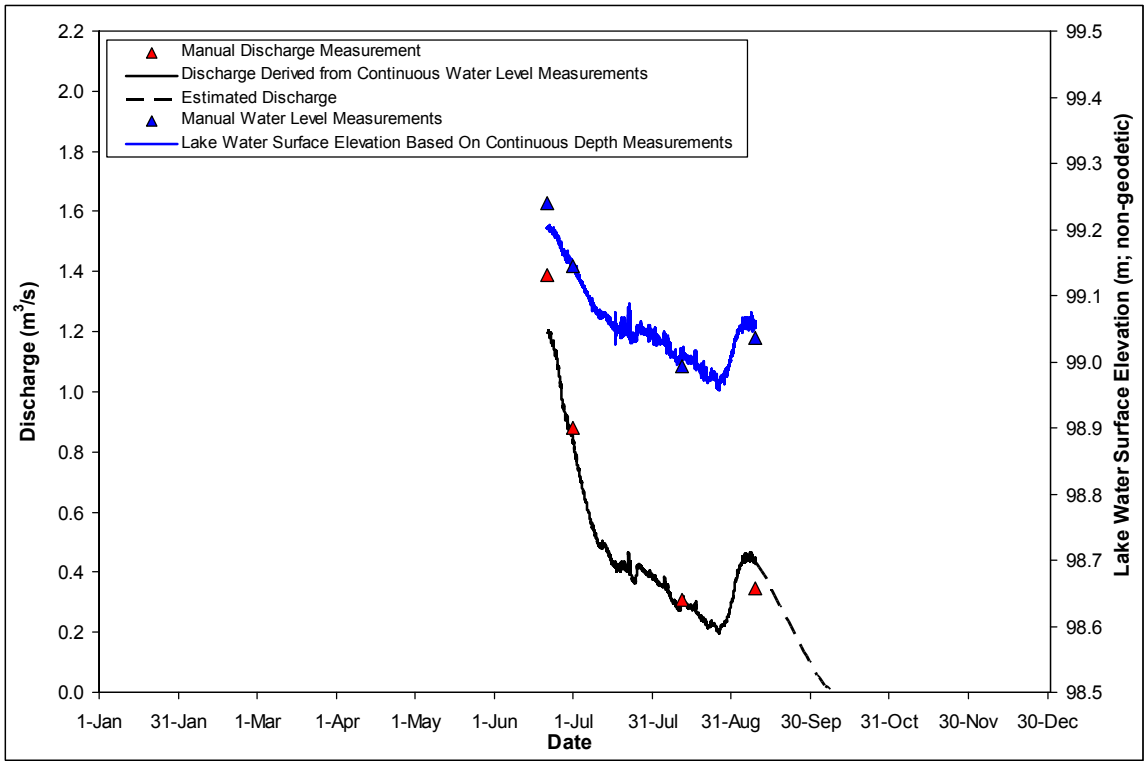



**Figure 2.19 Hydrograph for H81 Patch Lake and Outflow, June to September 2008**

## 2.5.4 H89 P.O. Outflow

A factsheet describing the location of the hydrometric station and equipment installed at H89 P.O. Outflow is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2007 to 2008, and mean daily discharge and water level data from 2008.

This station is located just above Ogama Lake and its drainage area includes the watershed located to the east of P.O. Lake. The H89 P.O. Outflow station was visited five times during the 2008 field program (Table 2.15). A continuous hydrograph was generated for the period from 21 June to 9 September 2008 (Figure 2.20). The discharge hydrograph between 10 September and 9 October 2008 was estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.15 Site Visits to H89 P.O. Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Outlet Channel | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 21 Jun | Installed pressure transducer and data logger and measured water surface elevation. | ✓ | 99.769 m | | |
| 22 Jun | Measured discharge. | | | ✓ | 2.53 $m^3/s$ |
| 4 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 99.530 m | ✓ | 1.24 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 99.156 m | ✓ | 0.400 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 99.381 m | ✓ | 0.816 $m^3/s$ |

Prepared by: DC Checked by: ZC

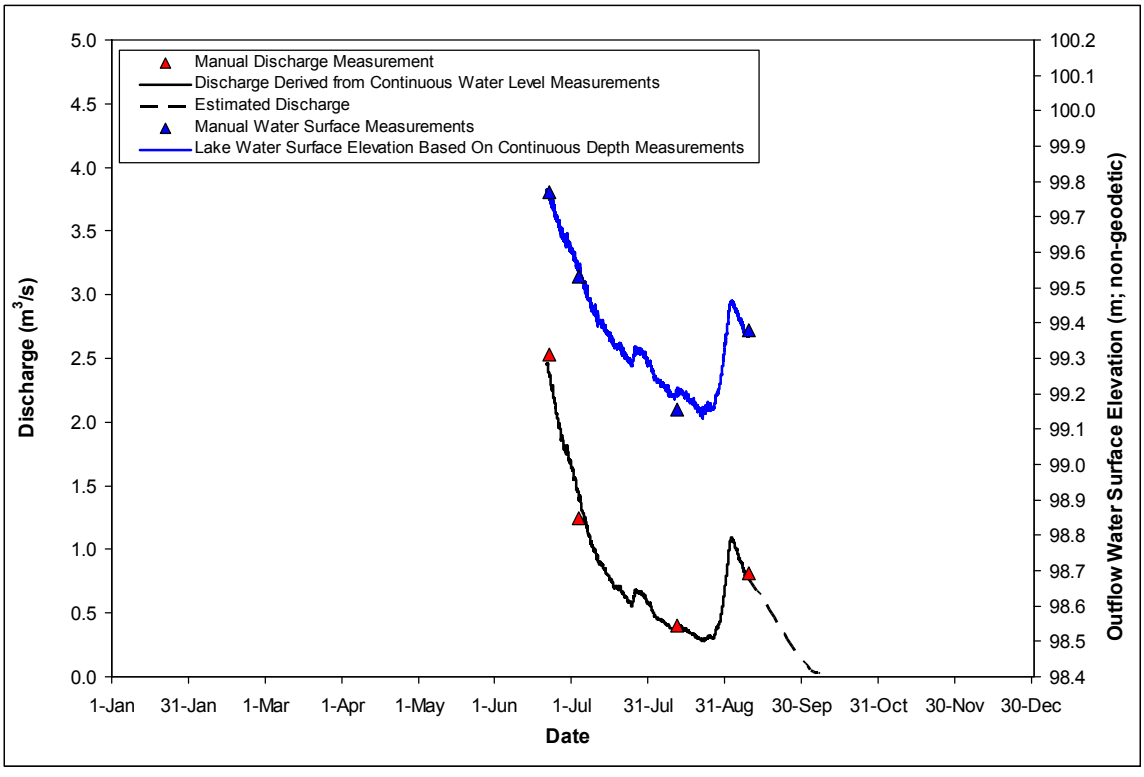



**Figure 2.20 Hydrograph for H89 P.O. Outflow, June to September 2008**

### 2.5.5 H90 P.O. Lake

A factsheet describing the location of the hydrometric station and equipment installed at H90 P.O. Lake is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

This station is located approximately 150 m above the narrows at the outlet of P.O. Lake proper, and its drainage area does not include the watershed located to the east of P.O. Lake. Water levels may be affected by backwater from the downstream lake area, into which the adjacent eastern watershed drains. H90 P.O. Lake was visited four times during the 2008 field program (Table 2.16). A continuous hydrograph was generated for the period from 21 June to 9 September 2008 (Figure 2.21). The hydrograph represents the continuous water level and manual discharge measurements only, as backwater effects from the downstream lake area precludes development of a single stage-discharge rating curve.

**Table 2.16 Site Visits to H90 P.O. Lake Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Discharge |
|---|---|---|---|---|
| 21 Jun | Installed pressure transducer and data logger and measured discharge and water surface elevation | ✓ | 99.796 m | 1.73 $m^3/s$ |
| 3 Jul | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 99.530 m | 1.06 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 99.156 m | 0.284 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 99.381 m | 0.465 $m^3/s$ |

Prepared by: DC Checked by: ZC

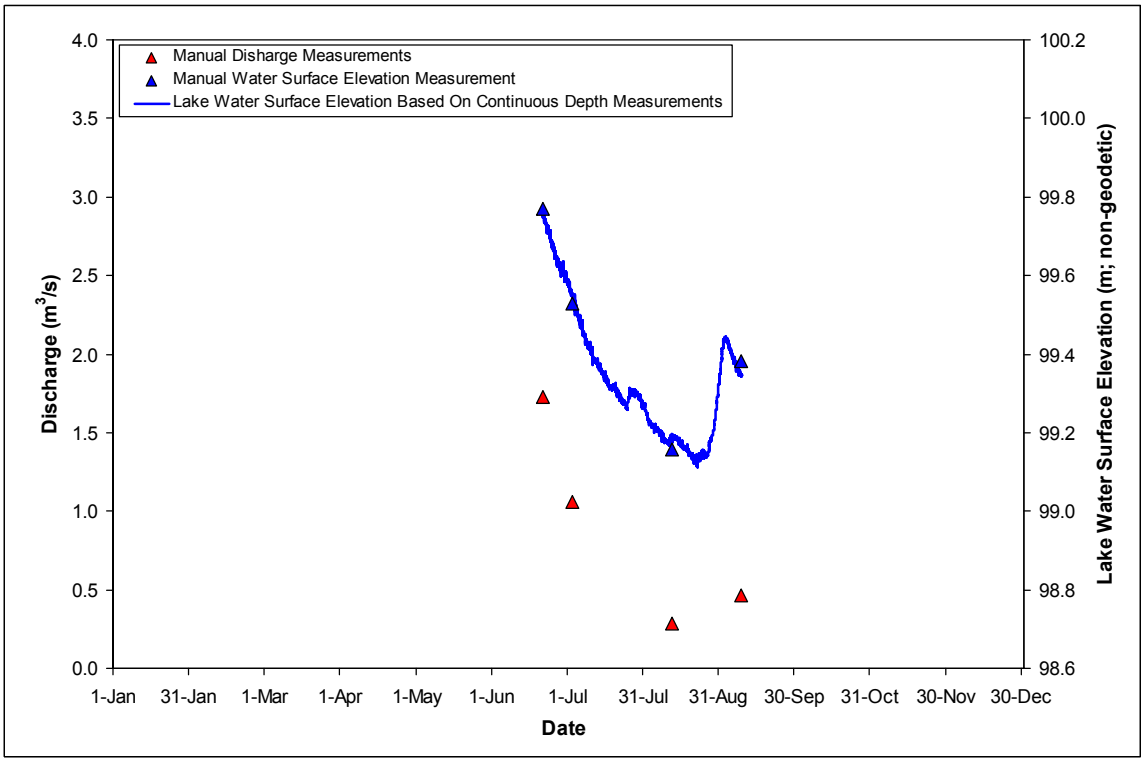



**Figure 2.21 Hydrograph for P.O. Lake, June to September 2008**

## 2.5.6 H92 Windy Lake and Outflow

A factsheet describing the locations of the hydrometric station and equipment installed at H92 Windy Lake and Outflow is provided in Appendix A3. The appendix also contains stage-discharge data from 2008, the derived stage-discharge rating curve based on data collected from 2006 to 2008, mean daily discharge and water level data from 2008, and manual discharge measurement data and calculation sheets from 2008.

The station was visited four times during the 2008 field program (Table 2.17). During the 1 July visit, the pressure transducer's readings were found to be out of range, and a new pressure transducer was installed on 2 July 2008.

A continuous hydrograph was derived from data collected from 2 July to 8 October 2008 (Figure 2.22). Discharges between 10 September and 8 October 2008 were estimated based on interpolation between the last measurement and the estimated freeze-up date.

**Table 2.17 Site Visits to H92 Windy Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) | Outflow | Discharge |
|---|---|---|---|---|---|
| 22 Jun | Installed staff gauge, pressure transducer and datalogger, measured discharge and water surface elevation. | ✓ | 98.594 m | ✓ | 0.322 $m^3/s$ |
| 2 Jul | Measured water surface elevation and discharge and replaced transducer and downloaded data logger. | ✓ | 98.590 m | ✓ | 0.337 $m^3/s$ |
| 12 Aug | Measured water surface elevation and discharge and downloaded data logger. | ✓ | 98.552 m | ✓ | 0.170 $m^3/s$ |
| 9 Sep | Measured discharge and water surface elevation, downloaded and removed data logger for winter. | ✓ | 98.544 m | ✓ | 0.218 $m^3/s$ |

Prepared by: DC Checked by: ZC

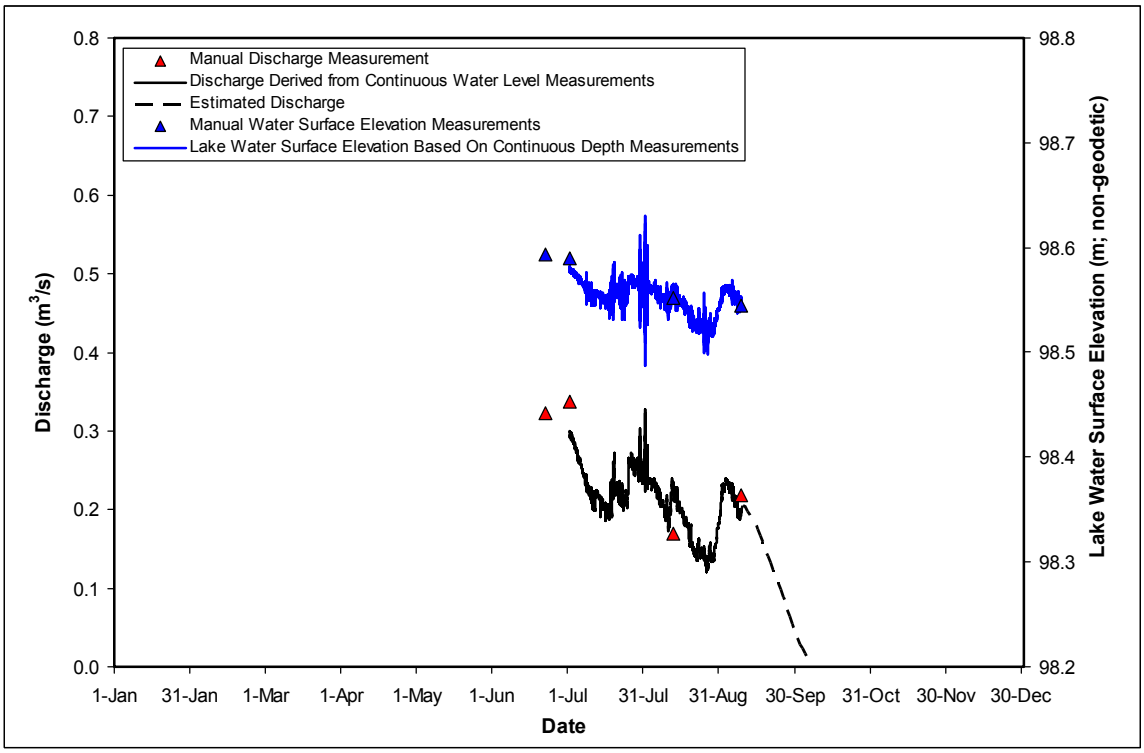



**Figure 2.22 Hydrograph for H92 Windy Lake and Outflow, June to September 2008**

### 2.5.7 H91 Wolverine Lake and Outflow

A factsheet describing the locations of the hydrometric station and equipment installed at H91 Wolverine Lake is provided in Appendix A3. The appendix also contains stage data and mean daily water level data for 2008.

The H91 Wolverine Lake and Outflow hydrometric station was visited four times during the 2008 field program (Table 2.18). A continuous hydrograph was derived for the period 18 June to 9 September (Figure 2.23). Discharges were observed on the south-east shoreline area in 2008, but reliable measurements were not possible because there is no defined outlet channel. The discharges occur through a wide area covered with shrubs that extends over approximately 200 m along the lake shoreline. Field observations from 2008 concluded that Wolverine Lake discharges to Patch Lake through a large wetland area with no defined channel even during high water levels in the spring.

**Table 2.18 Site Visits to H91 Wolverine Lake and Outflow Hydrometric Station, 2008**

| Date (2008) | Activities | Lake | Water Level (non-geodetic) |
|---|---|---|---|
| 18 Jun | Installed pressure transducer and datalogger and measured water surface elevation. | ✓ | 96.229 m |
| 4 Jul | Measured water surface elevation and downloaded data logger. | ✓ | 96.177 m |
| 12 Aug | Measured water surface elevation and downloaded data logger. | ✓ | 96.197 m |
| 9 Sep | Measured water surface elevation, downloaded and removed data logger for winter. | ✓ | 96.207 m |

Prepared by: DC Checked by: ZC

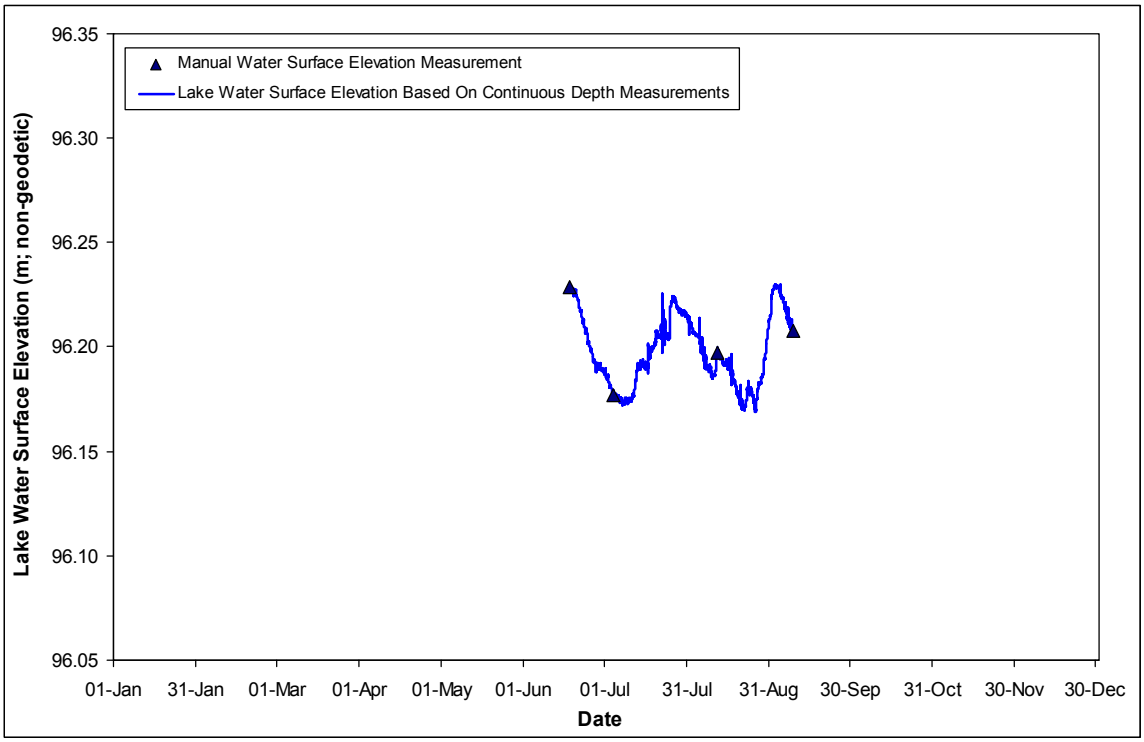
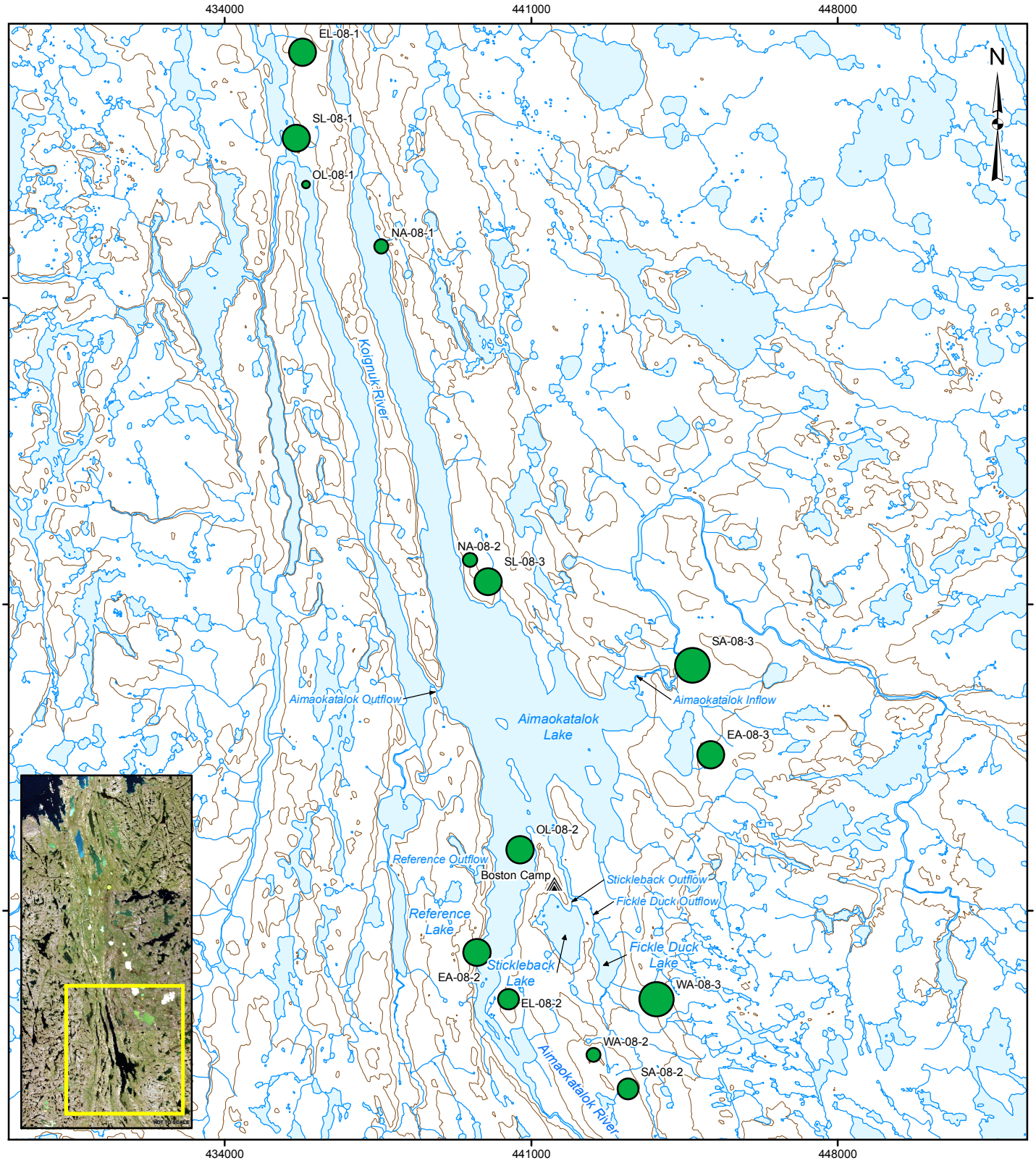



**Figure 2.23 Hydrograph for H91 Wolverine Lake and Outflow, June to September 2008**

## 2.6 SNOW COURSE SURVEYS

The water equivalent of a snowpack is a product of snow depth and density. Appendix A1 presents terrain type and snowpack measurement data collected in 2008 for the Boston Project Area, and Appendix A2 presents terrain type and snowpack measurement data collected in 2008 for the Doris and Madrid Project Areas. Sampling locations for the 2008 snow course survey program are presented in Figure 2.24 for the Boston Project Area and in Figure 2.25 for the Doris and Madrid Project Areas.

In the Boston Project Area, 14 sites over seven terrain types were examined during the snow course surveys in 2008. The data for each sampling site are provided in Table 2.19. Snow densities were similar across all terrain types with the exception of the north aspect terrain types, where values were lower. The mean snow depth ranged from 18.7 cm for open lake terrain to 45.6 cm for west aspect slope terrain. Snow water equivalents measured in the field ranged from 61.2 mm of water for north aspect terrain to 154.5 mm for west aspect terrain.




**LEGEND**

- CAMP
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY

**SNOW WATER EQUIVALENT (mm)**

- 24.2 - 50.0
- 50.1 - 75.0
- 75.1 - 100.0
- 100.1 - 150.0
- 150.1 - 260.0

3500 0 3500

SCALE 1:125000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008

Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 SNOW COURSE SURVEY SITES AND SNOW WATER EQUIVALENTS, BOSTON PROJECT AREA**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 2 |
|---|---|---|---|---|
| DESIGN | DC | 20 Nov. 2008 | | |
| GIS | RC | 29 Dec. 2008 | | |
| CHECK | AH | 29 Dec. 2008 | | |
| REVIEW | GA | 29 Dec. 2008 | | |

**FIGURE: 2.24**

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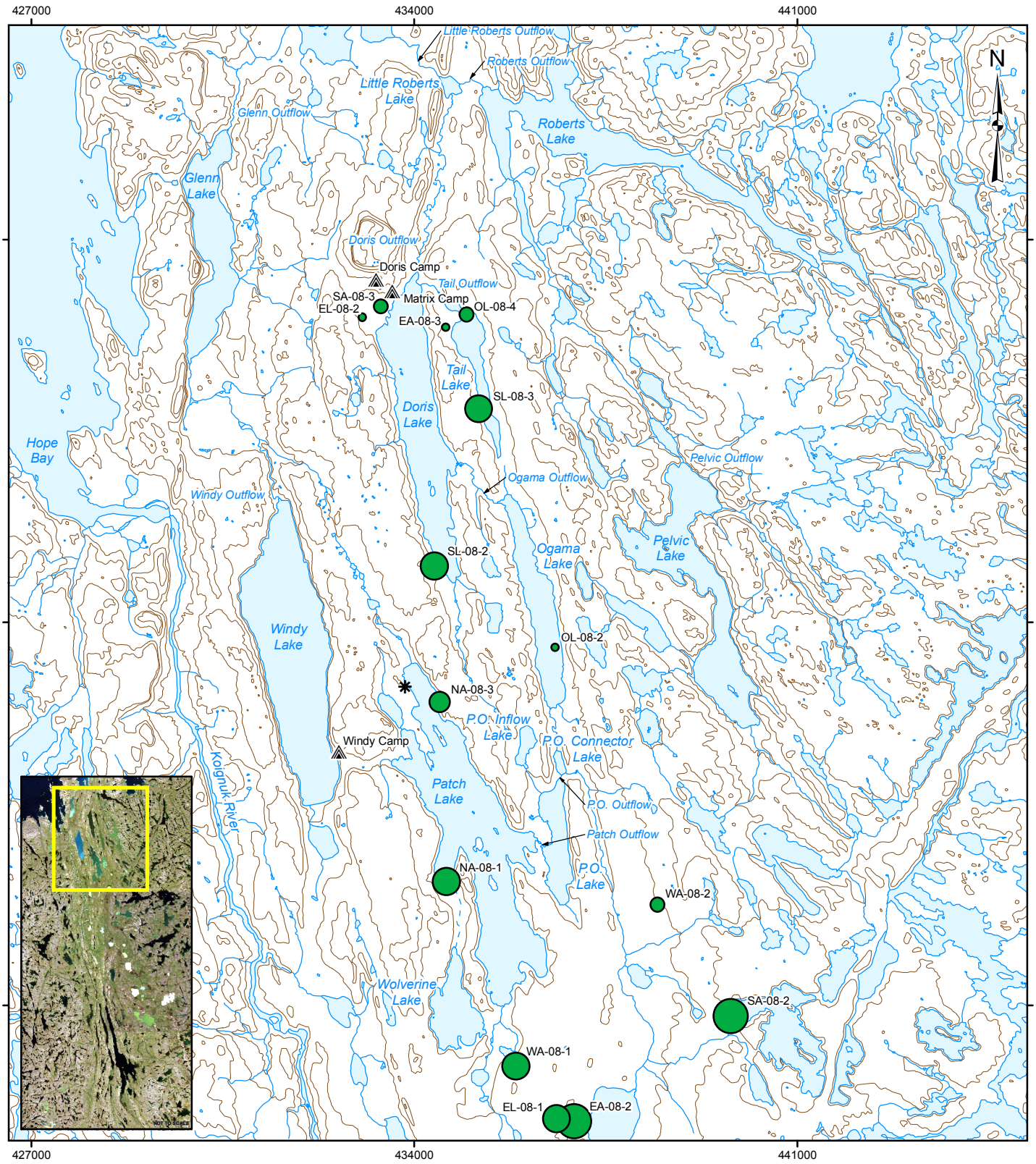


**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

**SNOW WATER EQUIVALENT (mm)**

- 24.2 - 50.0
- 50.1 - 75.0
- 75.1 - 100.0
- 100.1 - 150.0
- 150.1 - 260.0

3500 0 3500

SCALE 1:100000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 SNOW COURSE SURVEY SITES AND SNOW WATER EQUIVALENTS, DORIS AND MADRID PROJECT AREAS**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 2 |
|---|---|---|---|---|
| DESIGN | DC | 20 Nov. 2008 | | |
| GIS | RC | 29 Dec. 2008 | | |
| CHECK | AH | 29 Dec. 2008 | | |
| REVIEW | GA | 29 Dec. 2008 | | |

**FIGURE: 2.25**

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**Table 2.19 Snow Course Survey Data for Boston Project Area, May 2008**

| Terrain Type | Survey Plot Number | Snow Density ($g/cm^3$)[a] | Snow Depth (cm)[b] | Snow Water Equivalent (mm) |
|---|---|---|---|---|
| Open Lake | **OL-08-1** | 0.379 | 11.5 | 43.6 |
| | **OL-08-2** | 0.394 | 25.9 | 102.0 |
| | **2008 Mean** | 0.386 | 18.7 | 72.8 |
| Exposed Lowland | **EL-08-1** | 0.384 | 30.9 | 118.6 |
| | **EL-08-2** | 0.370 | 23.3 | 86.3 |
| | **2008 Mean** | 0.377 | 27.1 | 102.5 |
| Sheltered Lowland | **SL-08-1** | 0.330 | 34.2 | 112.9 |
| | **SL-08-3** | 0.457 | 23.7 | 108.3 |
| | **2008 Mean** | 0.394 | 28.9 | 110.6 |
| North Aspect | **NA-08-1** | 0.229 | 31.5 | 72.2 |
| | **NA-08-2** | 0.347 | 14.5 | 50.2 |
| | **2008 Mean** | 0.288 | 23.0 | 61.2 |
| East Aspect | **EA-08-2** | 0.279 | 50.5 | 140.6 |
| | **EA-08-3** | 0.414 | 34.7 | 143.6 |
| | **2008 Mean** | 0.346 | 42.6 | 142.1 |
| South Aspect | **SA-08-2** | 0.316 | 28.0 | 88.5 |
| | **SA-08-3** | 0.381 | 57.3 | 218.7 |
| | **2008 Mean** | 0.349 | 42.7 | 153.6 |
| West Aspect | **WA-08-2** | 0.315 | 18.6 | 58.5 |
| | **WA-08-3** | 0.345 | 72.7 | 250.5 |
| | **2008 Mean** | 0.330 | 45.6 | 154.5 |

[a] Mean based on two density samples per plot.
[b] Mean based on 30 snow depth measurements per plot.

Prepared by: DC Checked by: ZC

In the Doris and Madrid Project Areas, 14 sites over seven terrain types were examined during the snow course surveys in 2008. The data for each sampling site are provided in Table 2.20. Snow densities were similar across terrain types with the exception of the open lake and west aspect terrain types, where values were higher. The mean snow depth ranged from 8.4 cm for open lake terrain to 38.1 cm for sheltered lowland terrain. In 2008, mean snow water equivalents ranged from 40.7 mm of water for open lake terrain to 116.3 mm for south aspect terrain.

**Table 2.20 Snow Course Survey Data for Doris and Madrid Project Areas, May 2008**

| Terrain Type | Survey Plot Number | Snow Density ($g/cm^3$)[a] | Snow Depth (cm)[b] | Snow Water Equivalent (mm) |
|---|---|---|---|---|
| Open Lake | **OL-08-2** | 0.420 | 5.8 | 24.2 |
| | **OL-08-4** | 0.522 | 10.9 | 57.1 |
| | **2008 Mean** | 0.471 | 8.4 | 40.7 |
| Exposed Lowland | **EL-08-1** | 0.304 | 49.1 | 149.1 |
| | **EL-08-2** | 0.216 | 11.3 | 24.4 |
| | **2008 Mean** | 0.260 | 30.2 | 86.8 |
| Sheltered Lowland | **SL-08-2** | 0.288 | 38.2 | 109.9 |
| | **SL-08-3** | 0.294 | 37.9 | 111.5 |
| | **2008 Mean** | 0.291 | 38.1 | 110.7 |
| North Aspect | **NA-08-1** | 0.402 | 30.6 | 122.9 |
| | **NA-08-3** | 0.300 | 25.7 | 76.9 |
| | **2008 Mean** | 0.351 | 28.1 | 99.9 |
| East Aspect | **EA-08-2** | 0.353 | 46.9 | 160.0 |
| | **EA-08-3** | 0.331 | 14.3 | 47.5 |
| | **2008 Mean** | 0.342 | 30.6 | 103.7 |
| South Aspect | **SA-08-2** | 0.307 | 53.2 | 163.2 |
| | **SA-08-3** | 0.331 | 21.0 | 69.5 |
| | **2008 Mean** | 0.319 | 37.1 | 116.3 |
| West Aspect | **WA-08-1** | 0.418 | 29.9 | 124.7 |
| | **WA-08-2** | 0.420 | 14.8 | 62.2 |
| | **2008 Mean** | 0.419 | 22.3 | 93.4 |

[a] Mean based on two density samples per plot.
[b] Mean based on 30 snow depth measurements per plot.

Prepared by: DC Checked by: ZC

Wind redistributes snowfall over the course of a winter. In general, less snow collects on exposed terrain, such as open lake areas, compared with sheltered lowlands or lake edges. Similarly, prevailing winds redistribute snow unequally across slopes of differing aspect. These effects may result in substantial differences between terrain types. This study involved a limited number of sampling sites in an area with little vegetation, and broad ranges of measured values were observed among all terrain types. For initial water balance calculations, an un-weighted mean snow water equivalent of 113.9 mm should be used for the Boston Project Area (Figure 2.24) and 93.1 mm for the Doris and Madrid Project Areas (Figure 2.25).

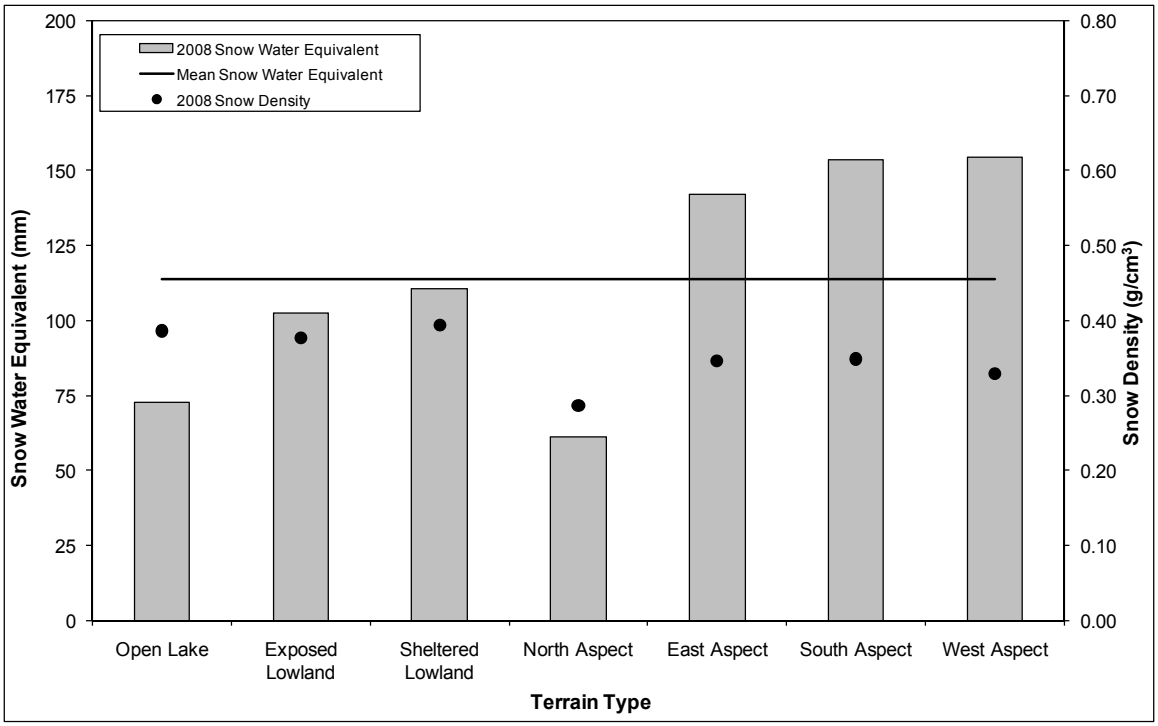



**Figure 2.26 Snow Course Survey Data for Boston Project Area, May 2008**

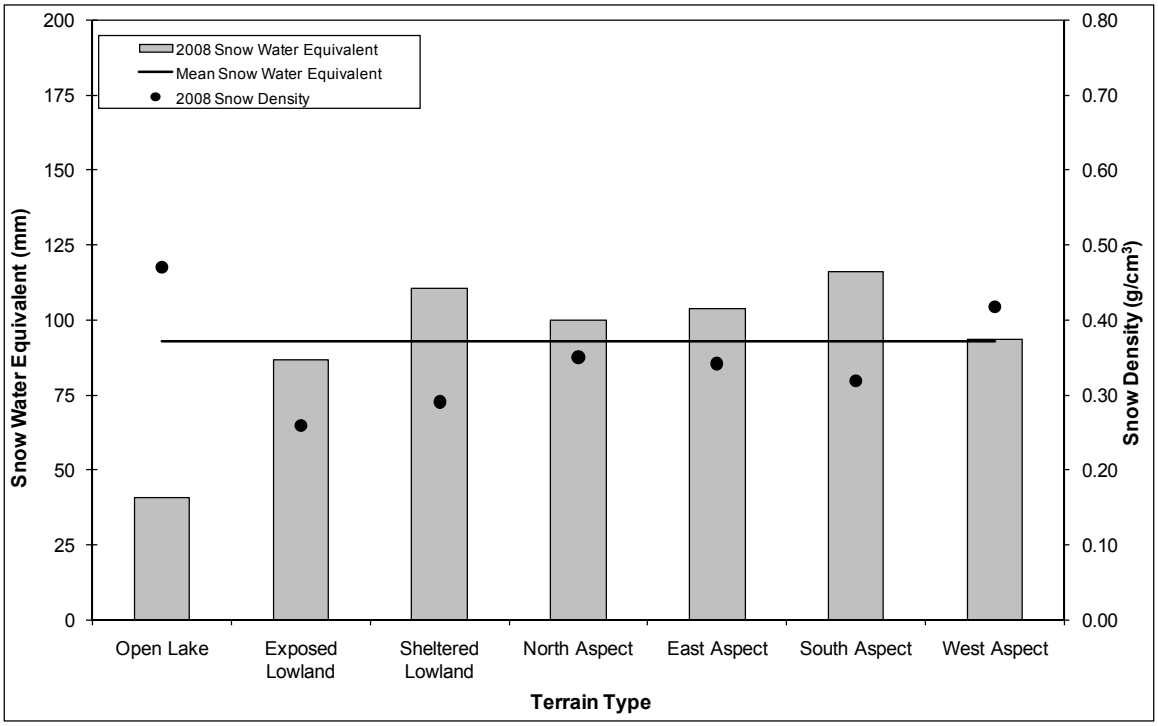



**Figure 2.27 Snow Course Survey Data for Doris and Madrid Project Areas, May 2008**

## 2.7 RAINFALL

Rainfall data were recorded at the Doris weather station in months when air temperatures were above 0°C, which generally included May to September 2008. An undercatch factor of 1.19 was applied to the measured rainfall values to account for the wind effects and trace rainfall events. At the Boston weather station, rainfall data are not available for the 2008 open water season due to malfunction of the tipping bucket rain gauge. Thus, only rainfall data from Doris climate station are presented.

The Doris weather station recorded 156.5 mm of rainfall between June and the end of September 2008. The undercatch-adjusted depth of 186.2 mm is much greater than the estimated baseline mean of 81.3 mm for that period (Table 2.21). Daily and annual cumulative rainfall values are plotted in Figure 2.28.

**Table 2.21 Monthly Rainfall Measured at Doris Meteorological Station, May – October 2008**

| Month | Measured Rainfall | Estimated Rainfall[a] | Baseline Mean Rainfall[b] |
|---|---|---|---|
| May[c, d] | 0.0 mm | 0.0 mm | 3.2 mm |
| June[c] | 25.1 mm | 29.9 mm | 13.7 mm |
| July[c] | 38.6 mm | 45.9 mm | 24.2 mm |
| August | 39.4 mm | 46.9 mm | 29.0 mm |
| September | 53.3 mm | 63.5 mm | 14.4 mm |
| October[d] | 0.0 mm | 0.0 mm | 1.2 mm |
| **Total[c]** | **156.5 mm** | **186.2 mm** | **85.7 mm** |

Prepared by: DC Checked by: ZC

[a] Values incorporate an undercatch factor of 1.19.

[b] Source: AMEC (2003). Values incorporate an undercatch factor of 1.19.

[c] Baseline mean rainfall for the period June through September is 81.3 mm.

[d] All triggers of the tipping bucket rain gauge recorded in May and October 2008 were during subzero temperatures and are assumed to be due to solar heat induced snowmelt.

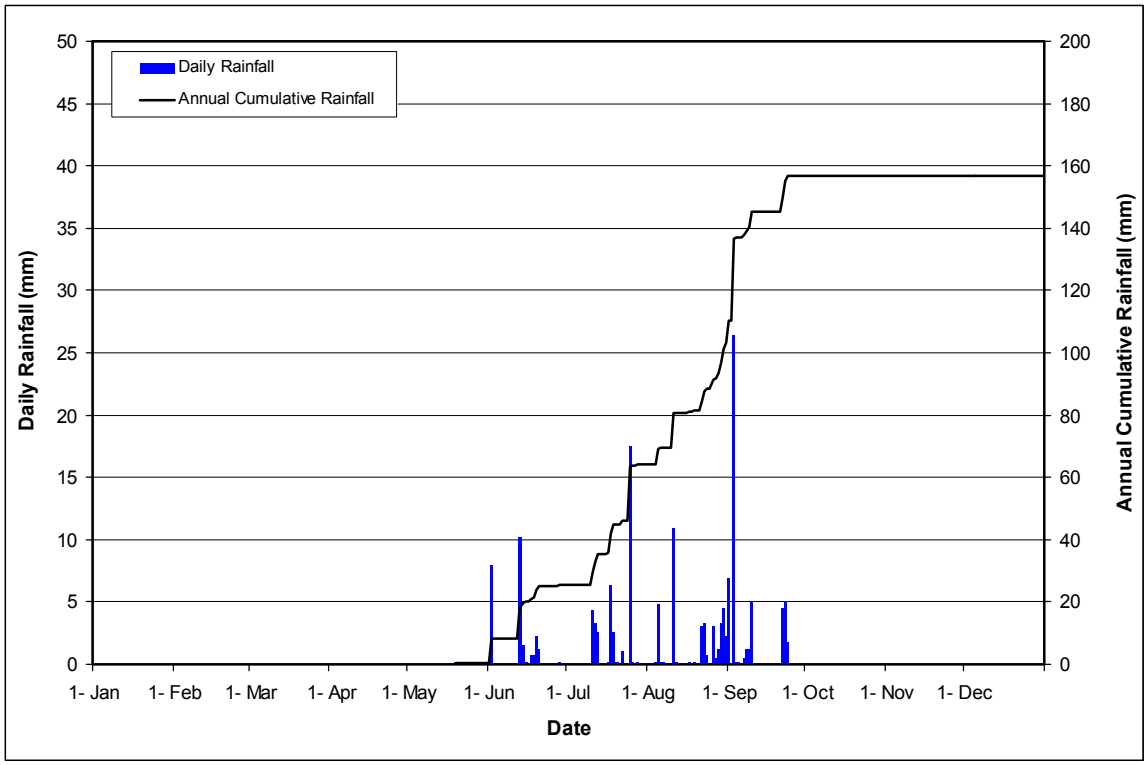



**Figure 2.28 Rainfall Data from Doris Weather Station, June to September 2008**

A comparison with the previous years (from 2005 to 2007) shows that the 2008 season was relatively wet. The June to September undercatch-adjusted rainfall at Doris Weather Station in 2008 was over double the baseline value and approximately double that measured in the next wettest years of 2005 and 2007. The most extreme difference between baseline and 2008 values was for the month of September, in which the undercatch-adjusted value was approximately four times the baseline value.

Monthly and annual values are presented in Table 2.22 and incorporate an undercatch factor of 1.19. Monthly and annual rainfall values are plotted in Figure 2.29.

**Table 2.22 Monthly and Annual Rainfall at Doris Weather Station, 2005 – 2008**

| Month | 2005 Rainfall | 2006 Rainfall | 2007 Rainfall | 2008 Rainfall | Baseline Mean Rainfall |
|---|---|---|---|---|---|
| June | 21.5 mm | 26.3 mm | 2.7 mm | 29.9 mm | 13.7 mm |
| July | 32.3 mm | 11.2 mm | 10.6 mm | 45.9 mm | 24.2 mm |
| August | 37.2 mm | 4.2 mm | 70.7 mm | 46.9 mm | 29.0 mm |
| September | 3.6 mm | 2.4 mm | 6.6 mm | 63.5 mm | 14.4 mm |
| **Annual** | **94.6 mm** | **44.1 mm** | **90.7 mm** | **186.2 mm** | **81.3 mm** |

Prepared by: DC Checked by: ZC

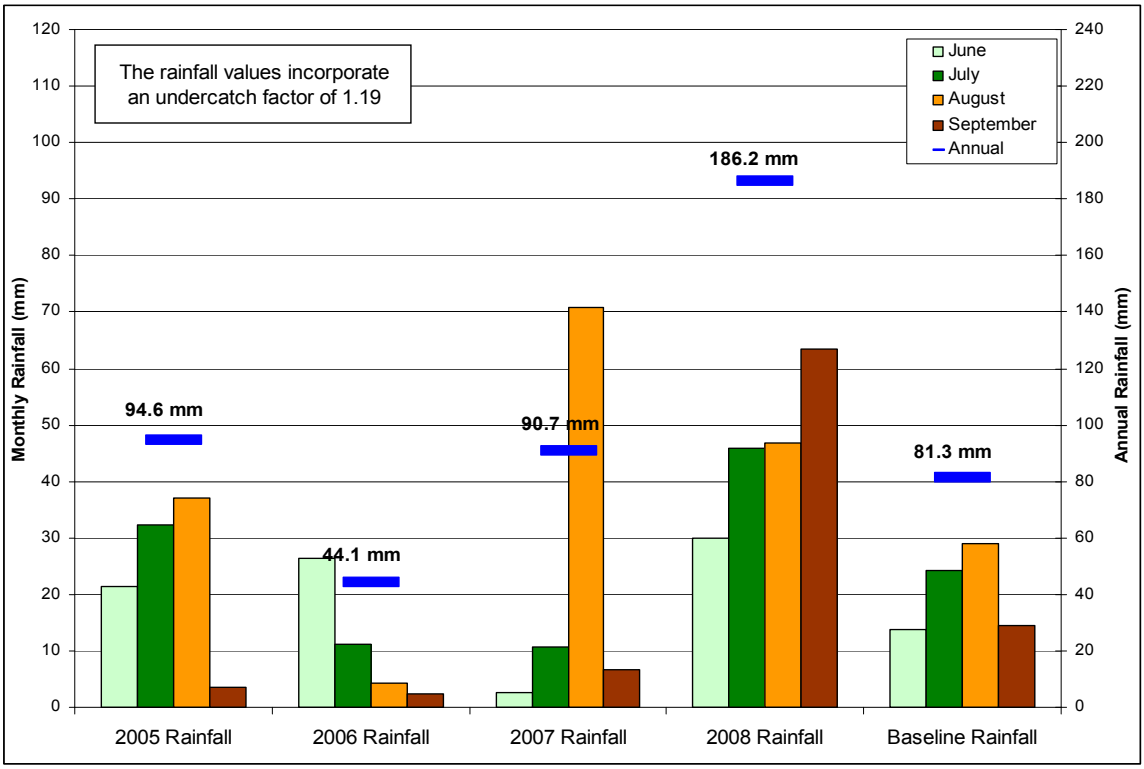



**Figure 2.29 Monthly and Annual Rainfall Data from Doris Meteorological Station**

# 2.8 HYDROMETRY DISCUSSION

## 2.8.1 Boston Project Area

The 2008 hydrometric program in the Boston Project Area continued the previous two years of monitoring in the Aimaokatalok Lake watershed. Water surface elevations and discharge data were collected during the 2008 open water season at five hydrometric stations, including H83 Aimaokatalok River, H84 Aimaokatalok Lake and Outflow, H85 Koignuk River, H86 Fickle Duck Lake and Outflow, and H87 Stickleback Lake and Outflow.

At H86 Fickle Duck Lake and Outflow, the datalogger was installed under snow conditions and the rise in lake water levels during spring thaw submerged the data logger; thus, data for the first part of the season are not available. The rest of the hydrometric stations operated continuously over the entire open water season with no malfunctions. The station at H84 Aimaokatalok Lake and Outflow was installed in deep water and collected data under ice-covered conditions over the winter of 2007 to 2008.

The peak flow was not clearly recorded for the hydrometric stations installed at the end of the winter season. However, the H84 Aimaokatalok Lake and Outflow station was maintained over the winter and recorded a peak lake water level on 23 June.

Annual water yields for the Aimaokatalok Lake and Stickleback Lake watersheds were calculated based on the derived hydrographs and watershed areas and are presented in Table 2.23.

**Table 2.23 Calculated Water Yields for Aimaokatalok Lake and Stickleback Lake Watersheds, 2008**

| Watershed | Total Annual Discharge ($m^3$) | Watershed Area ($km^2$) | Annual Water Yield (mm) |
|---|---|---|---|
| Aimaokatalok Lake [a] | 301 808 000 | 1241 | 243 |
| Stickleback Lake [b] | 590 000 | 2.8 | 211 |

[a] Hydrograph estimated before and after monitoring period.
[b] Hydrograph estimated only after monitoring period.

Prepared by: DC Checked by:ZC

The data show that 2008 was a wet year compared to previous years. Compared with the Doris Project Area, the water yield values are greater and represent conditions wetter than the long-term mean. The snow water equivalent available for Boston Project Area at the start of the thaw season in 2008 was greater than in the previous monitoring years (2006 and 2007) and greater than in the Doris Project Area in 2008 and resulted in high water levels during the spring freshet.

### 2.8.2 Doris Project Area

The 2008 hydrometry program for the Doris Project Area continued the previous years monitoring in the Little Roberts Lake system. Water surface elevations and discharge data were collected during the 2008 open water season at six hydrometric stations, including H71 Doris Outflow, H72 Roberts Lake and Outflow, H73 Little Roberts Outflow, H74 Doris Lake, H75 Tail Lake, and H76 Tail Outflow.

As in earlier years, the H73 Little Roberts Outflow hydrometric station was installed as a redundant measure, to allow discharges for the Doris Outflow or Roberts Outflow hydrometric stations to be back-calculated if either of those stations was to malfunction.

The Doris Lake and Tail Lake water level stations provided direct measurements of lake water surface elevation. They could also provide surrogate data to derive downstream discharges if required. The lake water level stations were installed in deep water in September 2004 to provide year-round data and collected data under ice-covered conditions over the winter of 2007-2008.

In 2008, all six hydrometric stations operated continuously over the entire open water season with no malfunctions. The peak flow of this season was recorded at the hydrometric stations and the discharge measurements allowed the existing rating curves to be updated. At H73 Little Roberts Outflow, the rating curve for high water levels was extrapolated using discharge information from the second visit to the site.

Annual water yields for the four monitored watersheds were calculated based on the derived hydrographs and watershed areas. These water yields are presented in Table 2.24, where the baseline mean water yield for each watershed is also shown.

**Table 2.24 Calculated Water Yields for Doris, Tail, Roberts and Little Roberts Watersheds, 2008**

| Watershed | Total Annual Discharge ($m^3$)[a] | Watershed Area ($km^2$) | Water Yield (mm) |
|---|---|---|---|
| | | | 2008 Annual |
| Tail Lake | 669 000 | 4.4 | 152 |
| Doris Lake | 14 268 000 | 93.1 | 153 |
| Roberts Lake | 16 657 000 | 97.8 | 170 |
| Little Roberts Lake | 30 087 000 | 189.9 | 158 |

[a] Hydrograph estimated before and after monitoring period.

Prepared by: DC Checked by: ZC

The data show that 2008 was a wet year compared to the previously derived mean annual water yields of 111 to 134 mm (AMEC 2003). This was due to a combination of the high snow water equivalent available at the start of the thaw season that resulted in high water level values during the spring, and the unusually large amount of rainfall during the open water season.

## 2.8.3 Madrid Project Area

The 2008 hydrometric program in Madrid Project Area continued the previous two years of monitoring in the Little Roberts Lake and Glenn Lake systems. Water surface elevations and discharge data were collected during the 2008 open water season at seven hydrometric stations, including H81 Patch Lake and Outflow, H82 Ogama Lake and Outflow, H89 P.O. Outflow, H90 P.O. Lake, H91 Wolverine Lake and Outflow, H92 Windy Lake and Outflow, and H93 Glenn Lake and Outflow. The hydrometric stations in the Madrid Project Area were installed during the spring high water levels and no stations were in place over winter.

The H91 Wolverine Lake and Outflow hydrometric station recorded only lake water surface elevations. This station appears to discharge only during spring runoff high water, through a wide area of shrubs with no defined channel.

The data loggers installed at H82 Ogama Lake and Outflow and at H92 Windy Lake and Outflow were found to be malfunctioning during the second visit to the sites, and they were replaced. This resulted in the first part of the hydrographs being excluded for Windy Lake and estimated for Ogama Lake, based on the first discharge measurement and the first available logged value.

Annual water yields were not calculated for these hydrometric stations because the peak flow was not clearly recorded by the transducers and thus reliable estimations and comparisons with similar watersheds were not possible.

### 2.8.4 Summary

The 2008 hydrometric program at the Hope Bay project was largely successful in collecting key data with which to characterize the annual water balance and its seasonal variation.

The use of a boat-mounted Acoustic Doppler Current Profiler (ADCP) at the larger river sites (Koignuk River, Aimaokatalok River, and Aimaokatalok Outflow) in 2008 proved very successful in collecting discharge data in non-wadeable conditions. This allowed the extension of stage-discharge rating curves beyond those established in previous years.

Spring freshet peak flow data were not collected at some sites, due to operational difficulties. Hydrology field crews were mobilized in mid-June, well before freshet, but were forced to stay in Cambridge Bay rather than locally at Windy Camp. From there, they depended on flights in and out of camp, experienced weather delays and had very limited helicopter time while on site. Water level monitoring equipment that over-wintered in deep water at Doris, Tail, and Aimaokatalok Lakes allowed the timing of the regional spring flood peaks to be characterized. However, monitoring equipment that was installed at other shallower lake stations under winter conditions, which had been a successful approach in previous years, resulted in ice damage to some pressure transducers. This caused early-season data gaps at some stations. Due to the number of monitoring sites and dependence of the onset of spring freshet on unpredictable local weather conditions, it is essential for field crews to stay locally and to have adequate transport provided to allow data to be collected during this period.

# 3 WATER QUALITY

## 3.1 INTRODUCTION

Water quality sampling was completed in the Boston, Madrid, and Doris Project Areas, which collectively comprise the Hope Bay Project Area. The purpose of the 2008 water quality program was to collect sufficient information for an overall spatial and temporal characterization of the water quality within the Project Area.

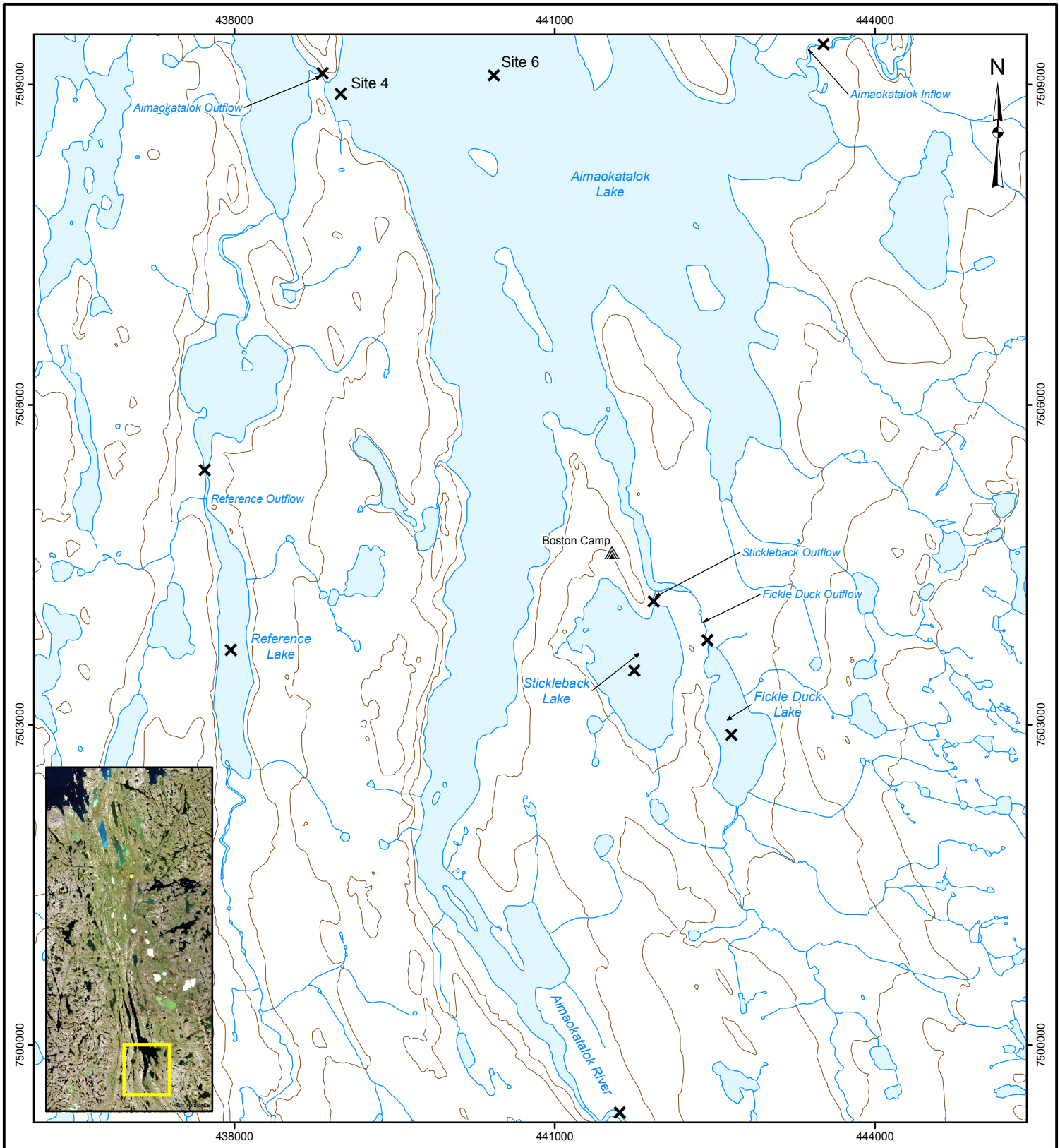
## 3.2 METHODS

### 3.2.1 Field Sampling Stations and Timing

The majority of 2008 water quality sampling stations in the Project Area were initially established in 2006 (Golder 2008b), with the Hope Bay and Glenn Lake sampling locations established in 2007 (Golder 2008b). Sampling stations in Doris, Tail, Roberts, and Little Roberts lakes and outflows were established in 2003 (RL&L/Golder 2003b), and the Roberts Bay sampling station was established in 2004 (Golder 2005). The sampling locations in Glenn and Stickleback lakes were relocated to deeper water in 2008.

Lakes and bays were sampled a minimum of three times between May and September 2008. Generally sites were sampled in ice-covered conditions in May, with open water conditions occurring during the July to September sampling periods. Under-ice sampling was not conducted in all lakes due to logistic constraints (i.e., camp accommodation, snow conditions to accommodate snowmachine access). Streams were sampled four times between June and September 2008 during open water conditions.

Sample stations were located using a Global Positioning System (GPS; hand-held Garmin GPS 76 with an accuracy of ±5 m). Universal Transverse Mercator (UTM) coordinates were recorded for each sampling station; all UTM coordinates were recorded in North American Datum (NAD) 83, Zone 13.




**LEGEND**

- CAMP
- WATER QUALITY SAMPLING STATION
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY

1500 0 1500

SCALE 1:50000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery captured in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

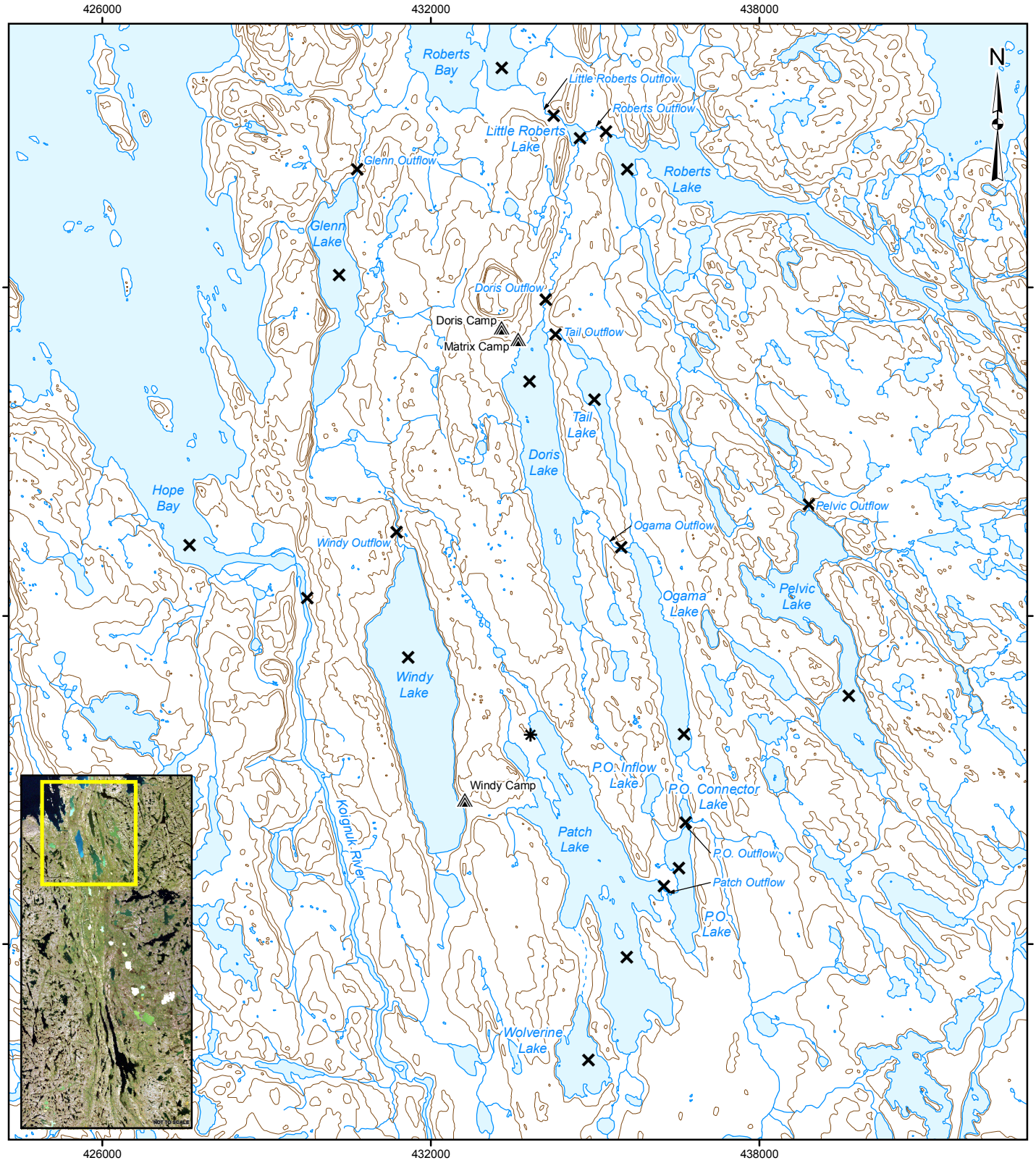
**2008 WATER QUALITY SAMPLING STATIONS BOSTON PROJECT AREA**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 29 Dec. 2008 | | |
| CHECK | AH | 29 Dec. 2008 | | |
| REVIEW | GA | 29 Dec. 2008 | | |

**FIGURE: 3.1**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig3_1_AQ_SL_WaterQuality_Boston08_09Jan2009.mxd




**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- WATER QUALITY SAMPLING STATION
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

3000 0 3000

SCALE 1:100000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 WATER QUALITY SAMPLING STATIONS DORIS AND MADRID PROJECT AREAS**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 9 Jan. 2009 | | |
| CHECK | AH | 9 Jan. 2009 | | |
| REVIEW | GA | 9 Jan. 2009 | | |

**FIGURE: 3.2**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig3_2_AQ_SL_WaterQuality_Madrid08_15Jan2009.mxd

### 3.2.1.1 Boston Project Area

The Boston Project Area includes Aimaokatalok, Fickle Duck, Stickleback, and Reference lakes, as well as the corresponding outflow streams and the Hope Bay marine site (Figures 3.1 and 3.2). One sampling station was established in all lakes, with the exception of Aimaokatalok Lake, where two stations (Sites 4 and 6) were located. There was one sampling station located in each of the Aimaokatalok River, Aimaokatalok Inflow, and Koignuk River.

All Boston Project Area lakes were sampled monthly during July, August, and September 2008; Aimaokatalok Lake was also sampled under-ice in May 2008. Three under-ice samples (top, middle, bottom) were collected in Aimaokatalok Lake Site 6 to assess differences in under-ice water quality within the water column. A total of 26 lake water quality samples were collected between 22 May and 15 September 2008 (Table 3.1).

**Table 3.1 Sampling Date and Number of Water Samples Collected in the Boston Project Area Lakes and Hope Bay, 2008**

| Date 2008 | Aimaokatalok Lake | | Fickle Duck Lake | Stickleback Lake | Reference Lake | Hope Bay | Total No.[a] |
|---|---|---|---|---|---|---|---|
| | Site 4 | Site 6 | | | | | |
| 22-May | 3 | 3[c] | | | | | 5 |
| 16-Jul | | | | | | 2 | 2 |
| 18-Jul | | | 1[d] | 1 | 1 | | 3 |
| 19-Jul | 2[b] | 2 | | | | | 4 |
| 14-Aug | 2 | 2 | 1 | 1 | | | 6 |
| 15-Aug | | | | | 1 | | 1 |
| 19-Aug | | | | | | 2 | 2 |
| 08-Sep | 2 | 2 | | | | | 4 |
| 09-Sep | | | 1 | 1 | 1 | | 3 |
| 13-Sep | | | | | | 2 | 2 |
| Total (Lakes) | 8 | 9 | 3 | 3 | 3 | | 26 |
| Total (Marine) | | | | | | 6 | 6 |

Prepared by: JM Checked by: CC

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 2 = one top and one bottom sample.

[c] 3 = one top, one middle, and one bottom sample.

[d] 1 = top sample only.

All streams were sampled monthly during the open water season between June and September 2008 (Table 3.2). A total of 28 stream water quality samples were collected between 23 June and 15 September 2008.

In 2008, one marine sampling station in Hope Bay was included in the water quality program. This station was initially included in 2007 because the Boston Project waterbodies flow into Hope Bay via the Koignuk River and have the potential to influence water quality. Six water quality samples were collected between July and September 2008 (Table 3.1).

**Table 3.2 Sampling Date and Number of Water Samples Collected in the Boston Project Area Streams, 2008**

| Date 2008 | Aimaokatalok | | | Koignuk River | Fickle Duck Outflow | Stickleback Outflow | Reference Outflow | Total No.[a] |
|---|---|---|---|---|---|---|---|---|
| | River | Inflow | Outflow | | | | | |
| 23-Jun | | | | 1[b] | | | | 1 |
| 24-Jun | 1 | 1 | 1 | | | | 1 | 4 |
| 26-Jun | | | | | 1 | 1 | | 2 |
| 17-Jul | | | | 1 | | | | 1 |
| 18-Jul | | | | | 1 | 1 | 1 | 3 |
| 19-Jul | 1 | 1 | 1 | | | | | 3 |
| 13-Aug | | 1 | 1 | | | | | 2 |
| 14-Aug | | | | | 1 | 1 | | 2 |
| 15-Aug | 1 | | | | | | 1 | 2 |
| 19-Aug | | | | 1 | | | | 1 |
| 08-Sep | | 1 | | | | | | 1 |
| 09-Sep | | | | | | 1 | 1 | 2 |
| 14-Sep | | | | 1 | | | | 1 |
| 15-Sep | 1 | | 1 | | 1 | | | 3 |
| **Total** | **4** | **4** | **4** | **4** | **4** | **4** | **4** | **28** |

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 1 = top sample only.

Prepared by: JM Checked by: CC

## 3.2.1.2 Doris Project Area

The Doris Project Area includes Doris, Tail, Little Roberts, and Roberts lakes as well as the corresponding outflow streams for all lakes (Figure 3.2). One water quality sampling station was established in each of the lakes and outflow streams.

All Doris Project lakes were sampled monthly during May (under ice), July, August, and September 2008. A total of 28 lake water quality samples were collected between 24 May and 12 September 2008 (Table 3.3). Outflow streams were sampled monthly during the open water season between June and September. A total of 16 water quality samples were collected between 19 June and 14 September 2008 (Table 3.4).

As in previous years, one marine sampling station in Roberts Bay was included in the water quality program because watersheds near the Doris Project Area flow into this bay and have the potential to influence water quality. Six water samples were collected between 16 July and 13 September 2008 (Table 3.3).

**Table 3.3 Sampling Date and Number of Water Samples Collected in the Doris Project Area Lakes and Roberts Bay, 2008**

| Date 2008 | Doris Lake | Little Roberts Lake | Roberts Lake | Tail Lake | Roberts Bay | Total No.[a] |
|---|---|---|---|---|---|---|
| 24-May | 2[b] | | | | | 3 |
| 25-May | | 1[c] | 2 | 2 | | 4 |
| 14-Jul | | 1 | | | | 1 |
| 15-Jul | | | 2 | 2 | | 4 |
| 16-Jul | 2 | | | | 2 | 4 |
| 17-Aug | 2 | | | | | 2 |
| 18-Aug | | 1 | 2 | 2 | | 5 |
| 19-Aug | | | | | 2 | 2 |
| 11-Sep | 2 | | | | | 2 |
| 12-Sep | | 1 | 2 | 2 | | 5 |
| 13-Sep | | | | | 2 | 2 |
| **Total (Lakes)** | **8** | **3** | **8** | **8** | | **22** |
| **Total (Marine)** | | | | | **6** | **6** |

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 2 = one top and one bottom sample.

[c] 1 = top sample only.

Prepared by: JM Checked by: CC

**Table 3.4 Sampling Date and Number of Water Samples Collected in the Doris Project Area Streams, 2008**

| Date (2008) | Doris Outflow | Little Roberts Outflow | Roberts Outflow | Tail Outflow | Total No.[a] |
|---|---|---|---|---|---|
| 19-Jun | | 1[b] | 1 | | 2 |
| 17-Jul | 1 | 1 | 1 | 1 | 4 |
| 22-Jun | 1 | | | 1 | 2 |
| 14-Aug | 1 | 1 | 1 | 1 | 4 |
| 12-Sep | 1 | | | 1 | 2 |
| 14-Sep | | 1 | 1 | | 2 |
| **Total** | **4** | **4** | **4** | **4** | **16** |

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 1 = top sample only.

Prepared by: JM Checked by: CC

### 3.2.1.3 Madrid Project Area

The Madrid Project Area includes Glenn, Windy, Pelvic, Ogama, Wolverine, Patch, and P.O. lakes, as well as corresponding outflows for all lakes except Wolverine Lake, which does not have a permanent outflow (Figure 3.2). One water quality sampling station was established in each of the lakes and outflow streams.

All Madrid Project lakes were sampled monthly during July, August, and September 2008. Patch, Windy, Wolverine, and Ogama lakes were also sampled in May. A total of 42 lake water quality samples were collected between 23 May and 14 September 2008 (Table 3.5). Outflow streams were sampled monthly during the open water season between June and September 2008. A total of 24 stream water quality samples were collected between 23 May and 14 September 2008 (Table 3.6).

**Table 3.5 Sampling Date and Number of Water Samples Collected in the Madrid Project Area Lakes, 2008**

| Date 2008 | Glenn Lake | Ogama Lake | Patch Lake | Pelvic Lake | P.O. Lake | Windy Lake | Wolverine Lake | Total No.[a] |
|---|---|---|---|---|---|---|---|---|
| 23-May | | | 2[b] | | | | 1[c] | 3 |
| 24-May | | 1 | | | | 2 | | 3 |
| 14-Jul | | | | | 1 | | 1 | 2 |
| 15-Jul | 2 | 2 | | 2 | | | | 6 |
| 17-Jul | | | 2 | | | | | 2 |
| 20-Jul | | | | | | 2 | | 2 |
| 15-Aug | | | 2 | | | | 1 | 3 |
| 16-Aug | | | | 2 | | | | 2 |
| 17-Aug | | 2 | | | 1 | | | 3 |
| 18-Aug | 2 | | | | | | | 2 |
| 19-Aug | | | | | | 2 | | 2 |
| 10-Sep | | 2 | 2 | | 1 | | 1 | 6 |
| 11-Sep | | | | 2 | | | | 2 |
| 13-Sep | 2 | | | | | | | 2 |
| 14-Sep | | | | | | 2 | | 2 |
| **Total** | **6** | **7** | **8** | **6** | **3** | **8** | **4** | **42** |

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 2 = one top and one bottom sample.

[c] 1 = top sample only.

Prepared by: JM Checked by: CC

**Table 3.6 Sampling Date and Number of Water Samples Collected in the Madrid Project Area Streams, 2008**

| Date 2008 | Glenn Outflow | Ogama Outflow | Patch Outflow | Pelvic Outflow | P.O. Outflow | Windy Outflow | Total No.[a] |
|---|---|---|---|---|---|---|---|
| 17-Jul | 1[b] | 1 | 1 | 1 | 1 | 1 | 6 |
| 19-Jun | 1 | | | | | | 1 |
| 21-Jun | | | 1 | 1 | 1 | | 3 |
| 22-Jun | | | | | | 1 | 1 |
| 23-Jun | | 1 | | | | | 1 |
| 19-Aug | 1 | 1 | 1 | 1 | 1 | 1 | 6 |
| 10-Sep | | | 1 | | 1 | | 2 |
| 11-Sep | | | | 1 | | | 1 |
| 13-Sep | 1 | | | | | | 1 |
| 14-Sep | | 1 | | | | 1 | 2 |
| **Total** | **4** | **4** | **4** | **4** | **4** | **4** | **24** |

[a] Excluding QA/QC samples – these are listed in Table 3.9.

[b] 1 = top sample only.

Prepared by: JM Checked by: CC

## 3.2.2 Field Sampling Procedures

All water quality sampling was completed according to the following Golder Technical Procedures (unpublished file information):

- 8.23-0: *Basic Limnology and Bathymetric Procedures*; and
- 8.3-1: *Surface Water Sampling Methods*.

### 3.2.2.1 Lakes and Bays

The water quality of the lakes and bays was characterized by measuring *in situ* physico-chemical water quality data and analyzing water quality samples for standard water quality parameters (e.g., total suspended solids [TSS]), major ionic composition, chlorophyll *a* (Chl *a*), nutrients, and trace metals concentrations.

#### *Physico-Chemical Water Quality*

Field measurements of physico-chemical water quality parameters (e.g., water temperature, dissolved oxygen (DO), conductivity, and pH) were recorded at each sampling station, except in Aimaokatalok Lake on 22 May 2008 because of

equipment malfunction. When possible, DO, temperature, and pH were measured using a laboratory-calibrated Hach HQ40-D probe (precision ±0.01 mg/L DO, ±0.01°C, ±0.01 pH units). Conductivity was measured with a Hanna pH/EC stick during open water conditions (±0.1 µS/cm). Under-ice DO, temperature, pH, and conductivity were measured using a field-calibrated Horiba U-22 multiparameter probe (precision ±0.01 mg/L DO and ±0.01°C, ±0.1 pH units, ±0.1 µS/cm). DO and temperature profiles were measured on at least three occasions in lakes within the Boston, Madrid, and Doris Project Areas, as well as in Hope and Roberts bays. DO and temperature were measured at 0.5 m intervals for lakes with water depth less than 10 m, and at 1.0 m intervals for lakes with water depth greater than 10 m. Measurements were taken along a vertical transect beginning at the water surface to 0.5 m above the bottom of the waterbody. The pH and conductivity were measured approximately 0.2 m below the water surface.

Transparency was determined using a standard 20 cm diameter Secchi disk. Secchi depth is measured by calculating the average of the depth that the disk disappears when it is lowered into the water column and the depth that it re-appears when it is raised back through the water column. This depth was used to estimate the euphotic depth within the water column (i.e., approximate depth to which 1% of incident light penetrates), which coincides with approximately twice the Secchi depth (Mitchell and Prepas 1990).

### *Chemical Analysis*

Water samples for chemical analysis were collected using a Trace Metals Acrylic Kemmerer water sampler, which was rinsed with ambient water prior to sample collection. Surface samples were collected 1.0 m below the water surface. Bottom samples were collected 1.0 m above the bottom of the water column to prevent contamination from sediments through physical disturbance of the surface benthic sediment layer. Appropriate preservatives were added in the field according to laboratory specifications, when required. All water chemistry samples were stored and transported on ice to the applicable analytical laboratory.

One litre of water for Chl *a* samples was collected within the euphotic zone using an integrated tube sampler. Sampling depth was determined using approximately two times the Secchi depth or the extent of the water column to 0.5 m above the bottom, whichever depth was less. The 1 L water sample was split into three replicate samples consisting of 0.33 L. Each replicate sample was filtered through a Whatman GF/C glass-fibre filter (0.26 mm pore size) using a syringe and attached filter holder. Each filter was treated with 1.0 to 1.5 mL of a magnesium carbonate ($MgCO_3$) suspension (> 1 mg $MgCO_3$ per 100 mL deionized water) to reduce the potential for Chl *a* degradation prior to analysis. Each filter was then carefully rolled

up, placed in an opaque vial, frozen, and transported in a dark, cold container to the analytical laboratory. Samples for Chl *a* analysis were kept frozen until analysis.

The *Metal Mining Effluent Regulations* (MMER) require mines to monitor radium-226 after the mine becomes subject to the MMER (see Table 6.1 in the Environmental Effects Monitoring Technical Guidance Document [Environment Canada 2002]). Radium-226 samples were analysed for the Boston and Madrid Project Area lakes and Hope Bay to provide one year of baseline data for comparison. The Doris Project Area lakes have radium-226 data from 2005.

#### 3.2.2.2 Streams

Field measurements of water temperature, DO, conductivity, and pH in streams were collected using the same procedures and instruments used at lake sampling stations. In addition, two water temperature data loggers (HOBO Water Temp Pro v2) were installed at each stream sampling station to record continuous water temperature readings (i.e., measurement recorded every 10 minutes) between June and September 2008. Two temperature data loggers were installed in each stream to provide redundancy in case one was lost/destroyed, or became dewatered. Each data logger was secured to the bank of the watercourse and anchored to the substrate using a weight. If at any time the temperature data logger was exposed to air (e.g., disruption by an animal, fast moving current, drop in water level), readings were identified and excluded from further analysis.

Water samples for chemical analysis taken from streams were collected approximately 0.1 m below the water surface. Sample collection and handling followed the same protocols used for lake water samples. Radium-226 samples were also analysed for the Boston and Madrid Project Area streams.

### 3.2.3 Laboratory Analytical Procedures

All freshwater samples were analyzed by Alberta Research Council (ARC), Vegreville, Alberta, with the exception of radium-226, which was analyzed by Saskatchewan Research Council (SRC), Saskatoon, Saskatchewan. All marine samples were analyzed by Maxxam Analytics Inc., Burnaby, British Columbia, with the exception of radium-226, which was also analyzed by SRC, and ultra-trace mercury, which was analyzed by ARC.

All water samples for chemical analysis were analyzed for the following parameters:

- general water quality – included total alkalinity, specific conductivity, total dissolved solids (TDS), total hardness, pH, total suspended solids (TSS), anions, cations, true colour, and ionic balance;
- nutrients – included total phosphorus, total Kjeldahl nitrogen, ammonia, nitrate, and nitrite;
- carbon species – particulate carbon, dissolved organic carbon, and total organic carbon;
- total and dissolved major ions – included bicarbonate, carbonate, calcium, chloride, magnesium, potassium, sodium, and sulphate;
- total and dissolved metals – included aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, uranium, vanadium, and zinc;
- radionuclide – included radium-226; and
- other – cyanide, fluoride, and sulphide.

Minimum Reported Values (MRVs) or Reported Detection Limits (RDLs) for each analytical laboratory are provided in Tables 3.7 and 3.8.

### 3.2.4 Data Analysis

Water quality data were summarized in tabular format, and a qualitative assessment (i.e., no statistical analysis) was completed as part of the characterization of existing baseline conditions in the Project Area. The discussion of results are provided for each lake and stream station for each of the three watersheds within the Project Area, with specific focus on general physico-chemical condition, nutrient, trace metal, and radionuclide concentrations. In particular, discussion of trace metal concentrations is limited to those that are higher the applicaple environmental guidelines. As part of this assessment, water quality summaries for some of the parameters required under the *Metal Mining Effluent Regulations* (MMER) (see Table 6.1 in the Environmental Effects Monitoring Technical Guidance Document [Environment Canada 2002]) were provided with comparison to previous years' data.

**Table 3.7 Water Quality Parameters and Corresponding Minimum Reported Values (MRVs) for Freshwater Samples from the Boston, Madrid and Doris Project Areas, 2008**

| Parameter | Unit | MRV | Parameter | Unit | MRV |
|---|---|---|---|---|---|
| ***pH, Conductivity, Hardness, Alkalinity, TDS, TSS and Colour*** | | | ***Metals - Total and Dissolved*** | | |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 1 | Aluminum (Al) | µg/L | 0.5 (0.2)[b] |
| Hardness, Total (as $CaCO_3$) | mg/L | 0.01 | Antimony (Sb) | µg/L | 0.0005 |
| Conductivity (EC) | µS/cm | 1 | Arsenic (As) | µg/L | 0.002 |
| pH | pH units | 0.1[a] | Barium (Ba) | µg/L | 0.004 |
| Total Dissolved Solids | mg/L | 0.1 | Beryllium (Be) | µg/L | 0.003 |
| Total Suspended Solids | mg/L | 1 | Bismuth (Bi) | µg/L | 0.001 |
| Colour, True | TCU | 1 | Boron (B) | µg/L | 0.03 |
| | | | Cadmium (Cd) | µg/L | 0.002 |
| ***Nutrients*** | | | Chromium (Cr) | µg/L | 0.03 |
| Phosphorous, Total | mg/L | 0.001 | Cobalt (Co) | µg/L | 0.001 |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | Copper (Cu) | µg/L | 0.05 |
| Ammonia-N | mg/L | 0.001 | Cyanide | mg/L | 0.001 |
| Nitrate+Nitrite-N | mg/L | 0.005 | Iron (Fe) | µg/L | 2 |
| Nitrite-N | mg/L | 0.001 | Lead (Pb) | µg/L | 0.001 |
| Nitrate-Na | mg/L | 0.005 | Manganese (Mn) | µg/L | 0.003 |
| | | | Mercury (Hg) | ng/L | 0.6 |
| ***Organics*** | | | Molybdenum (Mo) | µg/L | 0.001 |
| Dissolved Organic Carbon | mg/L | 0.2 | Nickel (Ni) | µg/L | 0.005 |
| | | | Selenium (Se) | µg/L | 0.1 |
| ***Major Ions*** | | | Silver (Ag) | µg/L | 0.0005 |
| Bicarbonate ($HCO_3$) | mg/L | 1 | Strontium (Sr) | µg/L | 0.004 |
| Calcium (Ca) | mg/L | 0.004 | Thallium (Tl) | µg/L | 0.0003 |
| Chloride | mg/L | 0.3 | Tin (Sn) | µg/L | 0.03 |
| Magnesium (Mg) | mg/L | 0.0001 | Uranium (U) | µg/L | 0.0001 |
| Potassium (K) | µg/L | 2 | Vanadium (V) | µg/L | 0.005 |
| Sodium (Na) | µg/L | 2 | Zinc (Zn) | µg/L | 0.1 (0.05) |
| Sulphate ($SO_4$) | mg/L | 3 | | | |
| | | | ***Other*** | | |
| ***Radionuclides*** | | | Fluoride (F) | mg/L | 0.01 |
| Radium-226 (Ra) | Bq/L | 0.005 | Sulphide | mg/L | 0.001 |

[a] This value reflects analytical precision
[b] MRV values in brackets are for dissolved metals. Metals without values in brackets indicate that total and dissolved MRVs are the same

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**Table 3.8 Water Quality Parameters and Corresponding Reported Detection Limits (RDLs) for Marine Samples from the Boston and Madrid Project Areas, 2008**

| Parameter | Unit | RDL (July) | RDL (Aug, Sept) | Parameter | Unit | RDL (July) | RDL (Aug, Sept) |
|---|---|---|---|---|---|---|---|
| ***pH, Conductivity, Hardness, Alkalinity, TDS, TSS and Colour*** | | | | ***Metals- Total and dissolved*** | | | |
| Alkalinity, Total (as $CaCO_3$) | mg/L | 0.5 | 0.5 | Aluminum (Al) | µg/L | 1 | 10 |
| Hardness, Total (as $CaCO_3$) | mg/L | 0.5 | 0.5 | Antimony (Sb) | µg/L | 0.5 | 0.5 |
| Conductivity (EC) | µS/cm | 1 | 1 | Arsenic (As) | µg/L | 0.1 | 0.5 |
| pH | pH units | 0.1[a] | 0.1[a] | Barium (Ba) | µg/L | 1 | 1 |
| Total Dissolved Solids | mg/L | 10 | 10 | Beryllium (Be) | µg/L | 0.1 | 1 |
| Total Suspended Solids | mg/L | 4 | 4 | Bismuth (Bi) | µg/L | 1 | 1 |
| Colour, True | TCU | 5 | 5 | Boron (B) | µg/L | 50 | 50 |
| | | | | Cadmium (Cd) | µg/L | 0.01 | 0.05 |
| ***Nutrients*** | | | | Chromium (Cr) | µg/L | 1 | 0.5 |
| Phosphorous, Total | mg/L | 0.005 | 0.005 | Cobalt (Co) | µg/L | 0.5 | 0.1 |
| Total Kjeldahl Nitrogen | mg/L | 0.02 | 0.02 | Copper (Cu) | µg/L | 0.2 | 0.5 |
| Ammonia-N | mg/L | 0.005 | 0.005 | Iron (Fe) | mg/L | 5 | 2 |
| Nitrate+Nitrite-N | mg/L | 0.02 | 0.02 | Lead (Pb) | µg/L | 0.2 | 0.1 |
| Nitrite-N | mg/L | 0.005 | 0.005 | Manganese (Mn) | µg/L | 1 | 0.5 |
| Nitrate-N | mg/L | 0.02 | 0.02 | Mercury (Hg) | ng/L | 0.6 | 0.6 |
| | | | | Molybdenum (Mo) | µg/L | 1 | 1 |
| ***Organics*** | | | | Nickel (Ni) | µg/L | 1 | 0.2 |
| Total Organic Carbon | mg/L | 0.5 | 0.5 | Selenium (Se) | µg/L | 0.1 | 0.5 |
| Dissolved Organic Carbon | mg/L | 0.5 | 0.5 | Silver (Ag) | µg/L | 0.02 | 0.05 |
| | | | | Strontium (Sr) | µg/L | 1 | 10 |
| ***Major Ions*** | | | | Thallium (Tl) | µg/L | 0.05 | 0.1 |
| Calcium (Ca) | mg/L | 0.05 | 1 | Tin (Sn) | µg/L | 5 | 1 |
| Chloride | mg/L | 0.5 | 0.5 | Titanium (Ti) | µg/L | 5 | 10 |
| Magnesium (Mg) | mg/L | 0.05 | 1 | Uranium (U) | µg/L | 0.1 | 0.05 |
| Potassium (K) | mg/L | 0.05 | 1 | Vanadium (V) | µg/L | 5 | 10 |
| Sodium (Na) | mg/L | 0.05 | 1 | Zinc (Zn) | µg/L | 5 | 1 |
| Sulphate ($SO_4$) | mg/L | 0.5 | 0.5 | Zirconium (Zr) | µg/L | 0.5 | 0.5 |
| Sulphide | mg/L | 0.005 | 0.005 | Calcium (Ca) | mg/L | 0.05 | 1 |
| | | | | | | | |
| ***Radionuclides*** | | | | ***Other*** | | | |
| Radium-226 | Bq/L | 0.005 | 0.005 | Fluoride (F) | mg/L | 0.01 | 0.01 |
| | | | | Sulphur (S) | mg/L | 3 | 20 |

Notes: RDL = Reported Detection Limit. July RDL values were different from the August and September RDL values.
[a] These values reflect analytical precision.

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#### 3.2.4.1 Comparison to Water Quality Guidelines

All baseline water chemistry results were compared to applicable federal Canadian Water Quality Guidelines (CWQG) for the Protection of Aquatic Life – Freshwater or Marine, as applicable (Canadian Council of Ministers for the Environment [CCME] 1987, 1999, 2007a, 2007b). The CWQG values are conservative as they err on the side of caution for the protection of aquatic life under daily exposure conditions. CWQGs are derived using data for the most sensitive test species, and are considered to protect all receptors 100% of the time (CCME 1999). Therefore, any substances with concentrations below CWQG values are unlikely to pose a substantial risk to aquatic life. If there was either no applicable CWQG or the CWQG was considered dated, then other provincial/national guidelines were used (e.g., United States Environmental Protection Agency [U.S. EPA]).

In addition, the water quality results for freshwater samples were compared to the Canadian Drinking Water Guidelines (CDWG) for human consumption (Health Canada 2008), and any exceedances were noted. These guidelines include both health-risk related guidelines and aesthetic objectives, and are presented for informational purposes only as the guidelines are generally applied to treated drinking water. Discussion of human health risks from the consumption of raw water are beyond the scope of this document.

The identification of a parameter exceeding a particular guideline does not necessarily indicate impaired environmental conditions. The use of the guidelines for comparative purposes allows a better understanding of parameters that may be more important to evaluate during the environmental assessment. It also provides a better understanding of existing conditions to which resident biological community would be accustomed. There are often site specific conditions related to geomorphology and geology that naturally result in locally elevated concentrations of various parameters within the aquatic environment (e.g., trace metals such as aluminium, copper, and selenium).

CWQGs for metals pertain to total metal concentrations, which consist of both the particulate and dissolved metal fractions (CCME 1999, 2007a). The bioavailability of most metals are affected by a number of environmental factors including pH, water hardness, oxidation-reduction conditions, and microbial degradation, as well as chemical speciation of specific metals (CCME 1987). Uncomplexed metal ions (e.g., cadmium, copper, lead and nickel) are usually more bioavailable than complexed forms (i.e., particulate forms) (CCME 1987). The development of metal species-specific guidelines are problematic due to problems related to analytical methods, which may result in

either overestimation or underestimation of the bioavailable fraction, as well as the relative toxicity of the different metal species. Therefore, comparisons using total concentrations of metals have been implemented as a protective measure (CCME 1987). In cases where the total metal concentration exceeds the applicable CWQG, the dissolved concentration has been assessed to determine if this also exceeds the CWQG. This results in a conservative assessment of CWQG exceedences.

In some instances, guidelines are dependent on other environmental variables (e.g., water hardness, pH). A number of guidelines are based on a range of values rather than a single value. Brief explanations of these parameters are provided in Appendix B1.

### 3.2.5 Quality Assurance/Quality Control

As part of the water quality QA/QC, field blanks, equipment blanks, and duplicate samples were collected (Table 3.9). These samples were submitted to laboratories listed above for analysis. A detailed discussion of QA/QC methodology is presented in Appendix B2.

## 3.3 RESULTS AND DISCUSSION: LAKES

The following section provides a discussion of the baseline water quality results in lakes within the Boston, Doris, and Madrid Project Areas. Detailed discussions for each lake are provided under respective lake headings and focus on general water quality characteristics, and water quality parameters that have specific guidelines or assessment criteria (e.g., TSS, pH, DO, TP), dissolved inorganic nitrogen (ammonia, nitrate, and nitrite), trace metals, radium-226, and total cyanide.

All field measurements, including water profiles of water temperature, and DO, as well as pH, conductivity, and Secchi depth values are provided in Appendices B3 and B4. Water chemistry data, including Chl *a* concentrations, are provided in Appendix B5. Water quality QA/QC data are presented in Appendix B2, and all concentrations that were higher than the CWQG and CDWGs from 2003 to 2008 are presented in Appendix B6.

**Table 3.9 Quality Assurance/Quality Control Samples for the Boston, Madrid and Doris Project Areas, 2008**

| Date 2008 | Boston | | | Doris | | Madrid | | | Total No. |
|---|---|---|---|---|---|---|---|---|---|
| | Field Blank | Duplicate | Equipment Blank | Field Blank | Duplicate | Field Blank | Duplicate | Equipment Blank | |
| 24-May | | | | | 1[a] | | | 1 | 2 |
| 21-Jun | | | | | | 1 | | | 1 |
| 22-Jun | | | | | | | 1 | | 1 |
| 24-Jun | 1 | | | | | | | | 1 |
| 16-Jul | | | | 1 | 1 | | | | 2 |
| 17-Jul | | | | | | 1 | 1 | 1 | 3 |
| 18-Jul | 1 | 1 | | | | | | | 2 |
| 19-Jul | | | 1 | | | | | | 1 |
| 14-Aug | | 1 | 1 | | | | | | 2 |
| 15-Aug | 1 | | | | | | | 1 | 2 |
| 17-Aug | | | | | 1 | | | | 1 |
| 18-Aug | | | | 1 | | | | | 1 |
| 19-Aug | | | | | | | 1 | | 1 |
| 20-Aug | | | | | | 1 | | | 1 |
| 9-Sep | 1 | 1 | 1 | | | | | | 3 |
| 10-Sep | | | | | | 1 | | 1 | 2 |
| 11-Sep | | | | 1 | | | | | 1 |
| 12-Sep | | | | | 1 | | | | 1 |
| 14-Sep | | | | | | | 1 | | 1 |
| **Total** | **4** | **3** | **3** | **3** | **4** | **4** | **4** | **4** | **29** |

[a] all lake samples were taken at the top

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## 3.3.1 Boston Project Area Lakes

### 3.3.1.1 Aimaokatalok Lake - Site 4 and Site 6

The two sampling stations in Aimaokatalok Lake are situated at different water depths. Site 4 is located in a moderately shallow area, with a depth of approximately 6.5 m, and Site 6 is located in a deeper region of the lake, with a depth of approximately 27 m.

Aimaokatalok Lake is characterized as a clear freshwater lake, with naturally soft water and a moderate to high acid sensitivity (Saffran and Trew 1996; Weiner 2000). The pH was near neutral (6.7 to 7.4) and within the CWQG range of pH 6.5 to 9.0 (CCME 2007a) and the CDWG of pH 6.5 to 8.5 (Health

Canada 2008). Concentrations of major ions were typically low, and dominated by sodium, chloride, and bicarbonate (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 2 mg/L at Site 4, and < 1 to 4 mg/L at Site 6. Secchi depths ranged between 2.0 and 2.6 m at both sampling stations (Figures 3.3 and 3.4; Appendix B3).

Water column profiles of temperature and DO concentrations were similar between Site 4 and Site 6 (Figures 3.3 and 3.4). Seasonal temperature trends were observed as expected (e.g., warmer water temperature in August compared to July and September). A gradual decline in temperature with depth was evident in July, but the temperature profiles for August and September were near isothermic. As such, no obvious thermal stratification was observed at either station during the open water season (Figures 3.3 and 3.4). The water columns at both stations were consistently well oxygenated (>11 mg/L) at depth (Figures 3.3 and 3.4). DO concentrations remained above the CWQG of 9.5 mg/L (CCME 1999), which is protective of all stages of cold freshwater aquatic life.

During the open water season, the range of total phosphorus concentrations at Sites 4 and 6 were similar, i.e., 9 and 18 µg/L and 9 and 21 µg/L, respectively. Chl *a* concentrations were low at both sites throughout the open water season (1.06 to 2.22 µg/L). Based on concentrations of total phosphorus and Chl *a*, Aimaokatalok Lake would be classified as naturally oligotrophic (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs (Appendix B5), and represented ≤ 10% of the total nitrogen concentration (the TKN ranged from 0.25 to 0.38 mg/L at Site 4, and 0.24 to 0.48 mg/L at Site 6).

Baseline total metal concentrations in both sites in Aimaokatalok Lake were not higher than relevant CWQGs or CDWGs. For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration.

Radium-226 concentrations were below the MRV (< 0.005 Bq/L) on all sampling occasions, with the exception of the top sample collected in May at Site 4 (0.010 Bq/L) and the top sample collected in September at Site 6 (0.005 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season, with the exception of the top sample collected in July at Site 4 (0.005 mg/L) (Appendix B5).

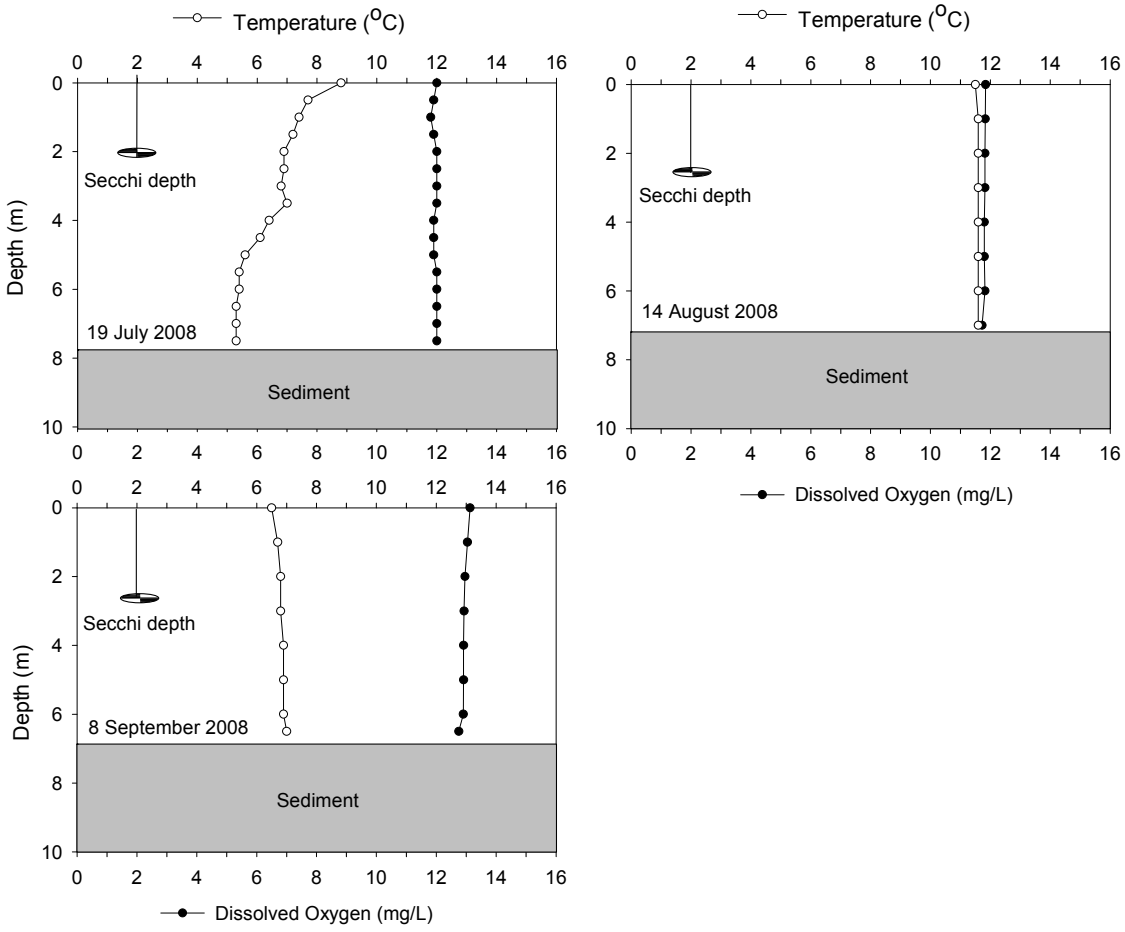


**Figure 3.3 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Aimaokatalok Lake – Site 4, 2008**

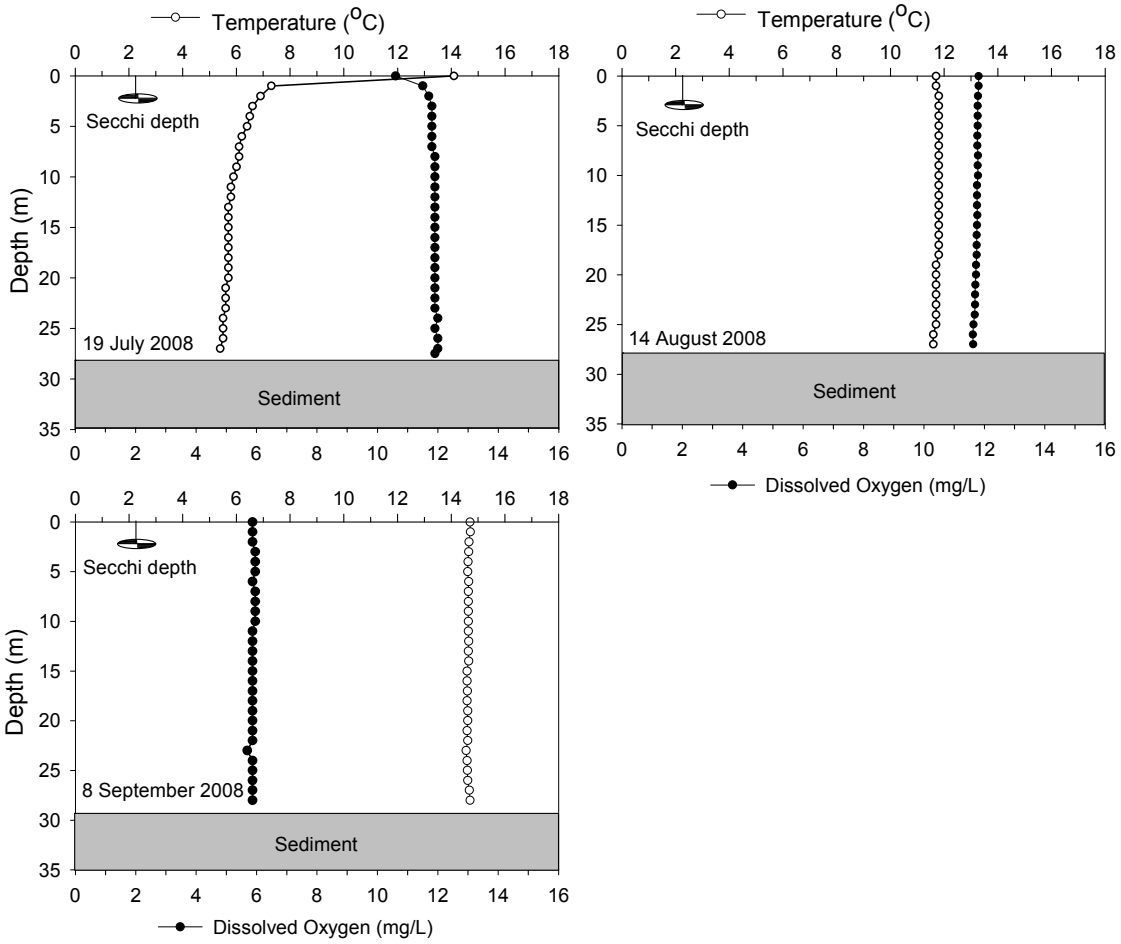


**Figure 3.4 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Aimaokatalok Lake – Site 6, 2008**

### 3.3.1.2 Fickle Duck Lake

Fickle Duck Lake is a shallow (< 3 m deep) freshwater lake. It is characterized by naturally soft water, with a moderate sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). Sampling was limited to open water conditions at this lake in 2008.

The pH was slightly alkaline (7.5 to 7.7) and within the CWQG (CCME 2007a) and the CDWG (Health Canada 2008) ranges. Concentrations of major ions were typically low, and dominated by sodium, calcium, and bicarbonate (Appendix B5).

Total suspended solids concentrations ranged from 1 to 4 mg/L, and the Secchi depths ranged between 1.3 and 1.5 m (Figure 3.5; Appendix B3).

No thermal stratification was observed in Fickle Duck Lake during the 2008 open water season (Figure 3.5). Typical seasonal temperature trends were observed, with warmer water column temperatures in July and August compared to September. The water column remained well oxygenated during the open water season (Figure 3.5), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

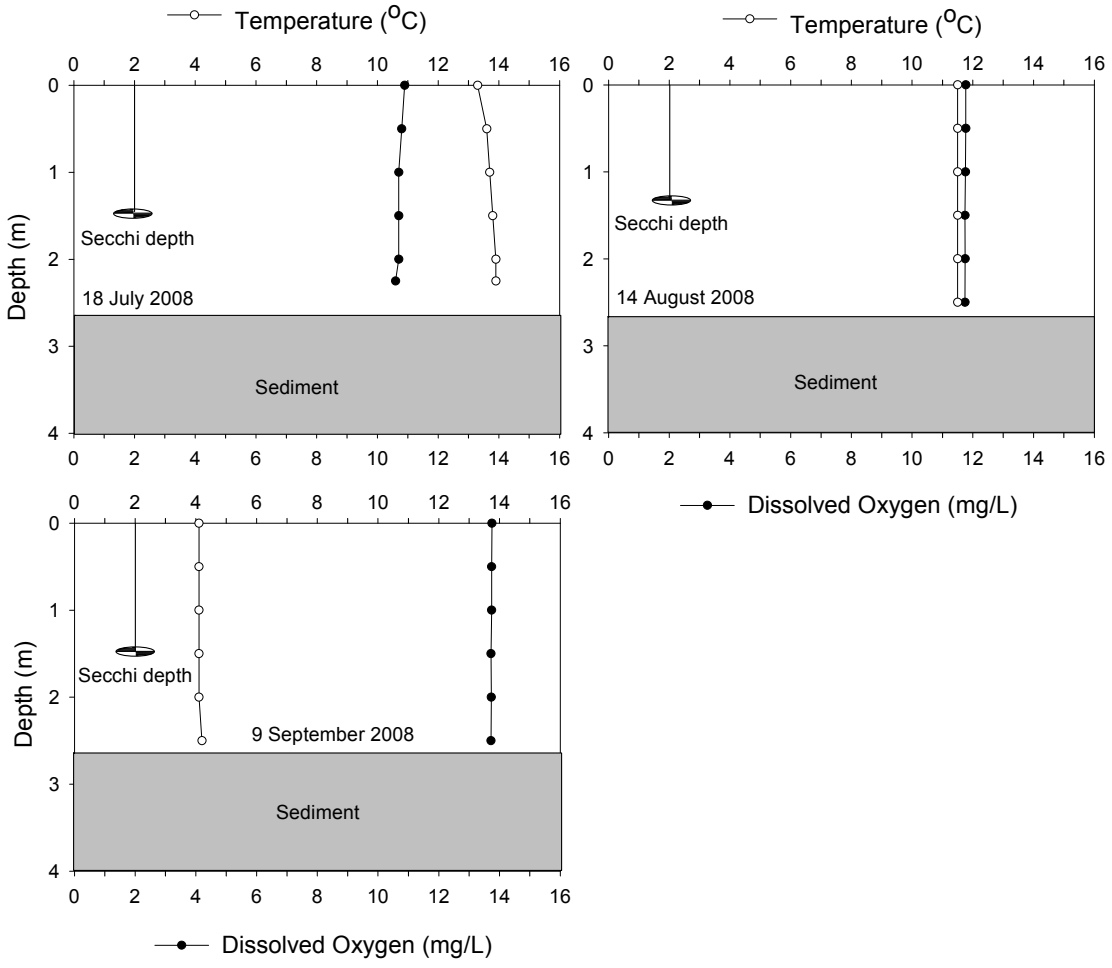


**Figure 3.5 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Fickle Duck Lake, 2008**

Total phosphorus concentrations in Fickle Duck Lake ranged from 13 µg/L (September) to 20 µg/L (July and August) (Appendix B5). Chl *a* concentrations showed a similar trend to total phosphorus, with a lower concentration measured in September (1.51 µg/L) than July (2.26 µg/L) and August (2.07 µg/L) (Appendix B5). Based on total phosphorus concentrations, Fickle Duck Lake would be classified as mesotrophic (Appendix B1) (CCME 2004); however, this lake would be classified as oligotrophic based on Chl *a* concentrations (Appendix B1) (Mitchell and Prepas 1990). The difference in trophic classification between the two parameters suggests that a large proportion of the total phosphorus consists of suspended particulate matter and detritus rather than phytoplankton. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs, and represented <6% of the total nitrogen concentration (the TKN ranged from 0.34 to 0.48 mg/L).

All baseline total metal concentrations were below applicable CWQGs, with the exception of total aluminum and total iron. These exceptions are as follows:

- Baseline total aluminum concentrations were 126 µg/L (July), 142 µg/L (September), and 153 µg/L (August) (Appendix B5), which were higher than the CWQG of 100 µg/L for pH conditions >6.5 (CCME 1999).

- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in July (401 µg/L) and August (571 µg/L) (Appendix B5).

Radium-226 concentrations were below the MRV (0.005 Bq/L) throughout the open water season. Total cyanide concentrations were also consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.3.1.3 Reference Lake

Reference Lake is a clear, shallow (< 4 m deep) freshwater lake. It is characterized by naturally soft water, with a moderate sensitivity to acidification (Saffran and Trew 1996). Sampling was limited to open water conditions at this lake in 2008.

The pH was near neutral to slightly alkaline (7.5 to 7.7) and was within the CWQG (CCME 2007a) and the CDWG (Health Canada 2008) ranges. Concentrations of major ions were typically low, and dominated by sodium, calcium, and bicarbonate (Appendix B5).

Total suspended solids concentrations ranged from 1 to 3 mg/L, and the Secchi depths ranged between 1.5 and 3.5 m (Figure 3.6; Appendix B3).

Thermal stratification was not observed in Reference Lake. Typical seasonal temperature trends were observed, with warmer water column temperatures in July and August compared to September. The water column remained well oxygenated throughout the open water season (>10.5 mg/L) (Figure 3.6), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

In Reference Lake, the concentration of total phosphorus ranged from 10 µg/L (September) to 15 µg/L (July). Chl *a* concentrations were low in July (1.98 µg/L) and August (2.28 µg/L), but increased substantially in September to 10.24 µg/L (Appendix B5). The highest Chl *a* concentration coincided with the deepest Secchi depth (3.5 m), which occurred in September. Taking into account concentrations of both total phosphorus and Chl *a*, Reference Lake would be conservatively classified as being within the upper range of oligotrophic to lower range of mesotrophic (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 5% of the total nitrogen concentration (the TKN ranged from 0.27 to 0.40 mg/L).

No CWQGs or CDWGs for baseline total metal concentrations were exceeded in Reference Lake. For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration.

Radium-226 concentrations were below the MRV (0.005 Bq/L) throughout the open water season. Total cyanide concentrations were also consistently below the MRV (0.001 mg/L).

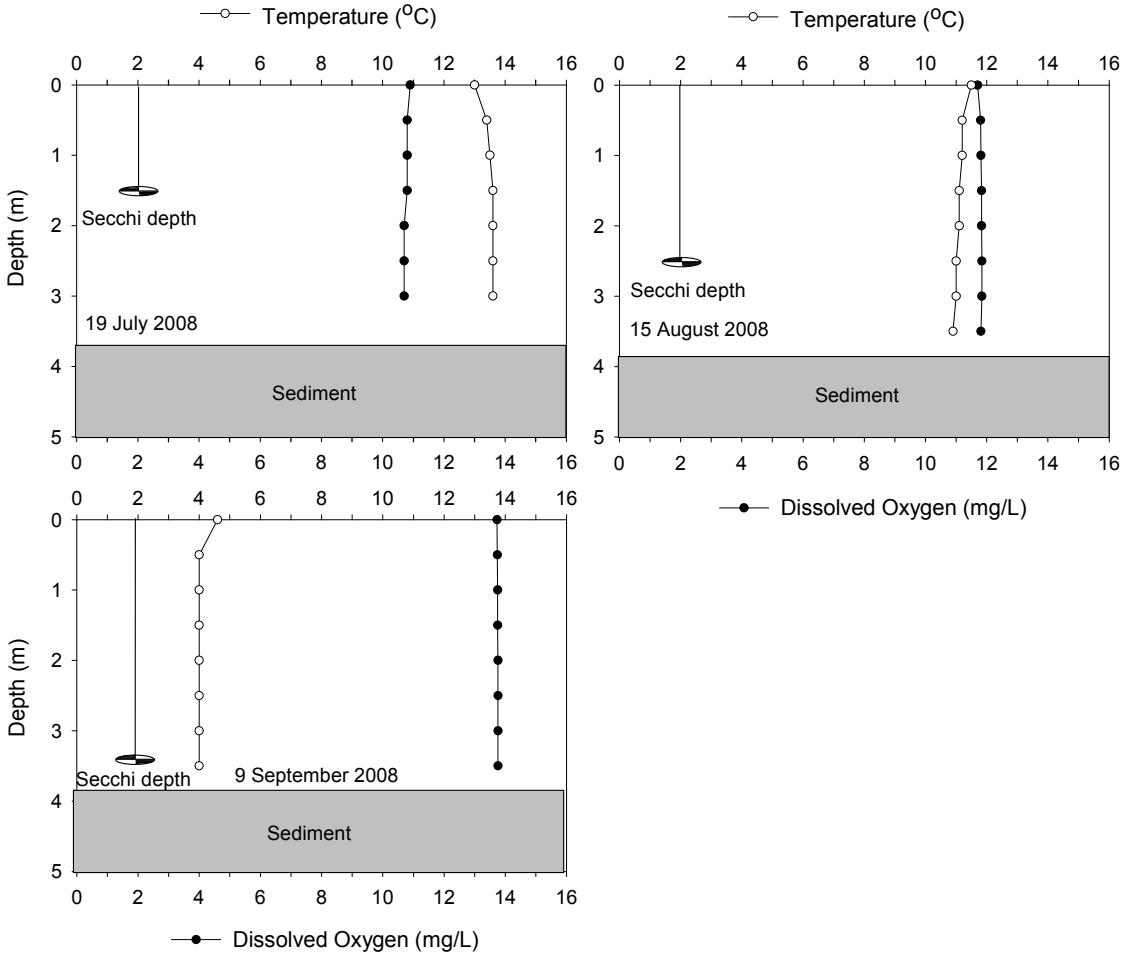


**Figure 3.6 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Reference Lake, 2008**

### 3.3.1.4 Stickleback Lake

Stickleback Lake is a very clear, shallow (approximately 3.5 m deep) freshwater lake. It is characterized by naturally soft water, with a low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). Sampling was limited to open water conditions at this lake in 2008.

The pH was near neutral to slightly alkaline (7.7 to 7.9) and was within the CWQGs (CCME 2007a) and the CDWGs (Health Canada 2008). Concentrations of major ions were approximately three times higher compared to other lakes

within the Boston Project Area (Appendix B5), and were dominated by sodium, calcium, chloride, and bicarbonate.

Total suspended solids concentrations were consistently below the MRV (1 mg/L), and the Secchi depths were equivalent to the lake bottom throughout the open water season (Figure 3.7).

No thermal stratification was observed in Stickleback Lake during the 2008 open water season (Figure 3.7). Typical seasonal temperature trends were observed, with warmer water column temperatures in July and August compared to September. The water column remained well oxygenated throughout the open water season (> 11 mg/L) (Figure 3.7), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

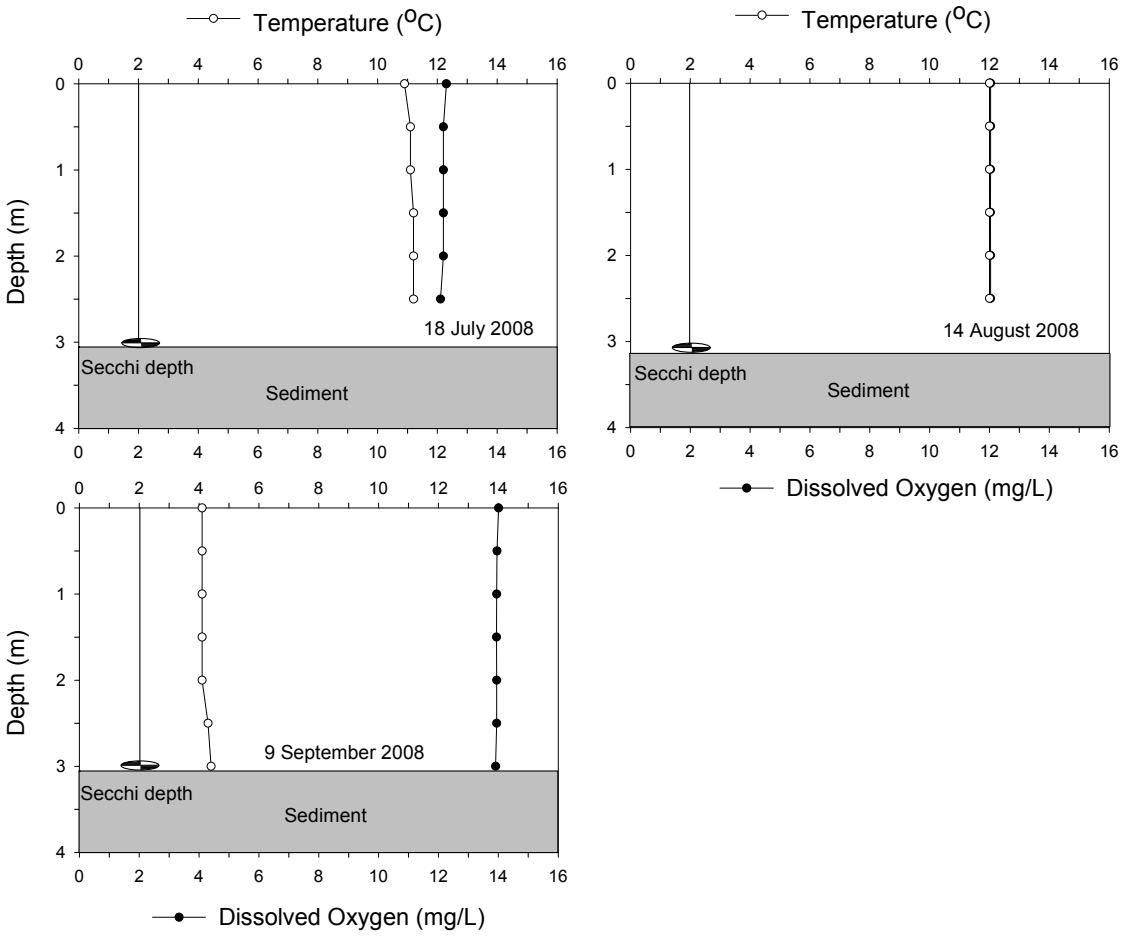


**Figure 3.7 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Stickleback Lake, 2008**

Total phosphorus concentrations in Stickleback Lake ranged between 7 and 13 µg/L, which included the lowest total phosphorus concentrations within lakes in the Boston Project Area (Appendix B5). Chl *a* concentrations were low, ranging between 1.15 and 1.76 µg/L (Appendix B5). Based on total phosphorus and Chl *a* concentrations, Stickleback Lake would be classified as naturally oligotrophic (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs, and represented < 5% of the total nitrogen concentration (the TKN ranged from 0.28 to 0.37 mg/L).

No CWQGs or CDWGs for baseline total metal concentrations were exceeded in Stickleback Lake. For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration.

Radium-226 concentrations were below the MRV (0.005 Bq/L) throughout the open water season. Total cyanide concentrations were also consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.3.1.5 Boston Project Area Lakes Summary

The background condition of lakes within the Boston Project Area were typically clear, with soft water, low TDS concentrations, and a moderate to high sensitivity to acidification, with the exception of Stickleback Lake. This lake had a low sensitivity to acidification because of higher TDS concentrations, and associated higher alkalinity and hardness. TDS concentrations were approximately three times the concentrations measured in the other Boston Project Area lakes, which suggests that the watershed may drain through slightly different geology or that there is a distinct groundwater input to this lake. Sodium, calcium, chloride, and bicarbonate were the dominant major ions. The range of pH values was near neutral to slightly alkaline for all lakes in the Boston Project Area.

No thermal stratification was evident during the open water season. The water column of each lake remained well oxygenated throughout open water conditions. DO concentrations at depth remained above the CWQG of 9.5 mg/L, which is protective of early life stages of freshwater aquatic life.

Based on total phosphorus and Chl *a* concentrations, the lakes were classified as oligotrophic (i.e., Aimaokatalok and Stickleback lakes), or oligotrophic to the lower range of mesotrophic (i.e., Fickle Duck and Reference lakes). All of the lakes in the Boston Project Area were phosphorus limited.

Total metal concentrations were rarely higher than CWQGs or CDWGs in the Boston Project Area lakes, with the exception of two metals in Fickle Duck Lake. Concentrations of total aluminum and iron were higher than relevant CWQGs, whereas total iron concentrations were higher than the CDWGs (Table 3.10). For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration. In 2006 and 2007, total aluminum, cadmium, copper, chromium, manganese, iron, and selenium were reported as being higher than relevant CWQGs or CDWGs in one or more of the Boston Project Area lakes (Appendix B6).

**Table 3.10 Baseline Parameters Above Guidelines in the Boston Project Area Lakes, 2008**

| Site | Water column Strata | Date (2008) | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) µg/L) | Iron (Total) µg/L) |
|---|---|---|---|---|---|---|
| | | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 300 µg/L |
| | | | CDWG 6.5 – 8.5[a] | | | CDWG <300 µg/L[a] |
| Fickle Duck Lake | Top | 18-Jul | 7.5 | 2 | **126** | **401** |
| | Top | 14-Aug | 7.6 | 2 | **153** | **371** |
| | Top | 9-Sep | 7.7 | 2 | **142** | |

CWQG=Canadian Water Quality Guideline; CDWG=Canadian Drinking Water Guideline

[a] Aesthetic objective.

TSS and pH are presented to help in interpretation of the values greater than the guidelines. **Bolded values** exceed the CWQG; **bolded and grey shaded values** exceeded the CDWG and CWQG.

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Baseline radium-226 and total cyanide concentrations in lakes within the Boston Project Area were generally below their corresponding MRVs. There were two exceptions in surface water samples collected in Aimaokatalok Lake: May (radium-226: Site 4 – 0.010 Bq/L; Site 6 – 0.005 Bq/L); and July (total cyanide: 0.005 mg/L).

A summary of background water quality parameters that often naturally exceed guidelines in Boston Project Area lakes are presented in Table 3.11, which includes summary data from 2006 and 2007. These parameters include some of the specific parameters required under the MMER (see Table 6.1 in the Environmental Effects Monitoring Technical Guidance Document [Environment Canada 2002]) in the Hope Bay Belt (i.e., parameters that were typically naturally higher than CWQGs or CDWGs in lakes within the Hope Bay Belt). Overall, median results from 2008 were generally consistent with the range of data collected in previous years (Table 3.11).

**Table 3.11 Summary of Select Baseline Water Quality Parameters in the Boston Project Area Lakes, 2006-2008**

| Parameter | Units | 2008 | | | | | 2006-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | pH units | 17 | 7.5 | 0.4 | 6.7 | 7.9 | 38 | 6.8 | 0.7 | 6.0 | 8.2 |
| TSS | mg/L | 26 | <1 | 0.9 | <1 | 4 | 57 | <1 | 1.5 | <1 | 10 |
| DO | mg/L | 17 | 11.8 | 1.2 | 10.4 | 14.0 | 32 | 10.8 | 2.5 | 1.9 | 15.5 |
| Conductivity | µS/cm | 26 | 52 | 59 | 35 | 240 | 57 | 56 | 103 | 46 | 643 |
| Total Phosphorous | µg/L | 26 | 13 | 4 | 7 | 21 | 57 | 15 | 21 | 6 | 162 |
| Aluminum | µg/L | 26 | 56 | 38 | 11 | 153 | 57 | 44 | 52 | 6.3 | 211 |
| Cadmium | µg/L | 26 | <0.002 | 0.0015 | <0.002 | 0.0056 | 57 | <0.002 | 0.0034 | <0.002 | 0.0238 |
| Copper | µg/L | 26 | 0.97 | 0.42 | 0.34 | 1.9 | 57 | 1.1 | 0.55 | 0.23 | 3.1 |
| Mercury | ng/L | 26 | 1.1 | 0.7 | <0.6 | 3 | 50 | 0.9 | 5.2 | <0.6 | 26 |
| Selenium | µg/L | 26 | 0.3 | 0.2 | <0.1 | 0.7 | 57 | 0.2 | 0.3 | <0.1 | 2.0 |
| Zinc | µg/L | 26 | 1.0 | 0.7 | <0.1 | 3.1 | 57 | 2.4 | 3.1 | 0.8 | 16 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen.

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## 3.3.2 Doris Project Area Lakes

### 3.3.2.1 Doris Lake

Doris Lake is a deep (approximately 20 m deep) freshwater lake. Its background condition is characterized by naturally soft water, with a low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). During under-ice conditions in May, the pH was slightly acidic (6.1), which is not unusual for late under-ice conditions; this value was below the CWQG of 6.5 for the protection of freshwater aquatic life (CCME 2007a) and also below the CDWG range. During the open water season, pH was neutral to alkaline (7.0 to 8.0) and was within the CWQG range (CCME 2007a) for the protection of freshwater aquatic life and the CDWG range for human consumption (Health Canada 2008).

Concentrations of major ions were higher compared to lakes within the Boston and Madrid Project Areas (with the exception of Stickleback Lake), with sodium, chloride, and bicarbonate as the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from 1 to 6 mg/L, and the Secchi depths ranged from 0.8 to 1.0 m (Figure 3.8), which indicated that Doris Lake had a lower water transparency compared to lakes in the Boston Project Area.

Thermal stratification was not detected during the under-ice and open water sampling events, although a slight surface layer discontinuity was evident in

the top 2 m in July (Figure 3.8; Appendix B4). Typical seasonal temperature trends were again observed, with warmer water column temperatures in July and August compared to September (Figure 3.8). During ice-covered conditions in May, DO concentrations ranged from 9.7 mg/L just above the sediment to 10.7 mg/L below the ice. The water column remained well oxygenated (≥10.7 mg/L) throughout the open water season (Figure 3.8; Appendix B4), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

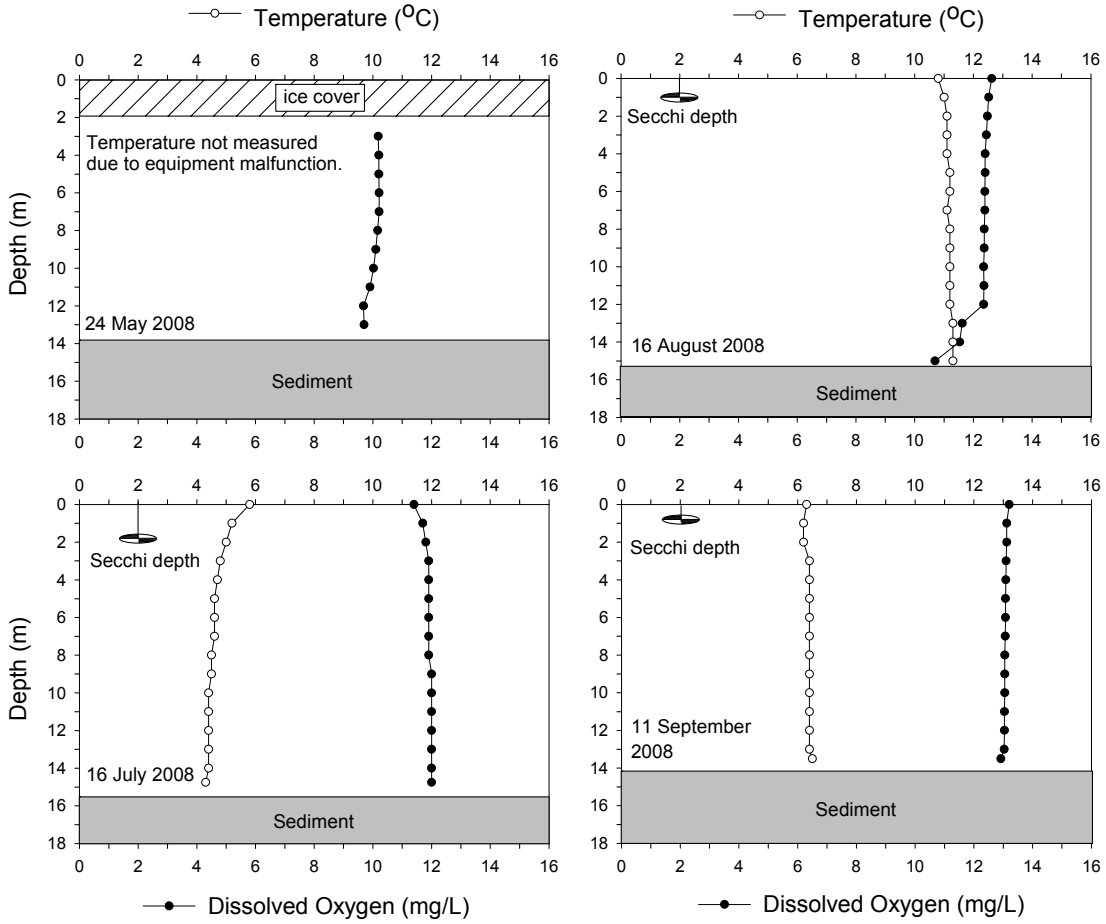


**Figure 3.8 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Doris Lake, 2008**

Total phosphorus concentrations in Doris Lake ranged between 25 and 34 µg/L, with slightly lower concentrations being observed in May and July. Chl *a* concentrations were moderate to high in July (7.89 µg/L) and September (15.86 µg/L), but exhibited a large, unexplained, decrease in August (0.56 µg/L)

(Appendix B5). Based on total phosphorus and Chl *a* concentrations, Doris Lake would be conservatively classified as a naturally mesotrophic lake (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and represented < 5% of the total nitrogen concentration (the TKN ranged from 0.47 to 0.59 mg/L).

With the exception of total aluminum and selenium, all other background total metal concentrations were below the CWQGs (CCME 2007a) and the CDWGs (Health Canada 2008). The exceptions are as follows:

- In May during under-ice conditions, total aluminum concentrations were 7.1 µg/L (top sample) and 14.3 µg/L (bottom sample), which was higher than the CWQG of 5 µg/L for pH conditions < 6.5 (CCME 2007a).
- Total selenium concentrations were slightly higher than the CWQG of 1 µg/L in August (top sample: 1.2 µg/L; bottom sample: 1.1 µg/L) (Appendix B5).

The proportion of the dissolved fraction of most metals was moderate to high, accounting for 50 to 100% throughout the under-ice and open water season.

Baseline radium-226 was not measured in the Doris Lake water samples as data on this parameter was consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) during under-ice and open water conditions (Appendix B5).

#### 3.3.2.2 Little Roberts Lake

Little Roberts Lake is a shallow (approximately 3 m deep) freshwater lake. The background condition is characterized by naturally soft water, with a low sensitivity to acidification during open water conditions, and a negligible acid sensitivity during late ice-covered conditions (Saffran and Trew 1996; Weiner 2000). During ice-covered conditions, the pH was slightly acidic (6.4), and during the open water season the pH was near neutral to slightly alkaline (7.3 to 7.8). Open water pH values were within the CWQGs; however, under ice-covered conditions, the pH was below the CWQG and CDWG of 6.5 (CCME 2007a; Health Canada 2008).

Concentrations of major ions were higher than lakes within the Boston and Madrid Project Areas, including Stickleback Lake, with sodium, chloride, and bicarbonate as the dominant ions (Appendix B5). Typically, TDS concentrations in the water column increase during under-ice conditions (Hammer 1986), with the level of

TDS increases directly related to the thickness of the ice and the water depth (e.g., TDS increases will likely be more pronounced in shallow lakes).

Total suspended solids concentrations ranged from 1 to 3 mg/L, with an associated shallow Secchi depth, ranging between 0.75 and 1.4 m (Figure 3.9).

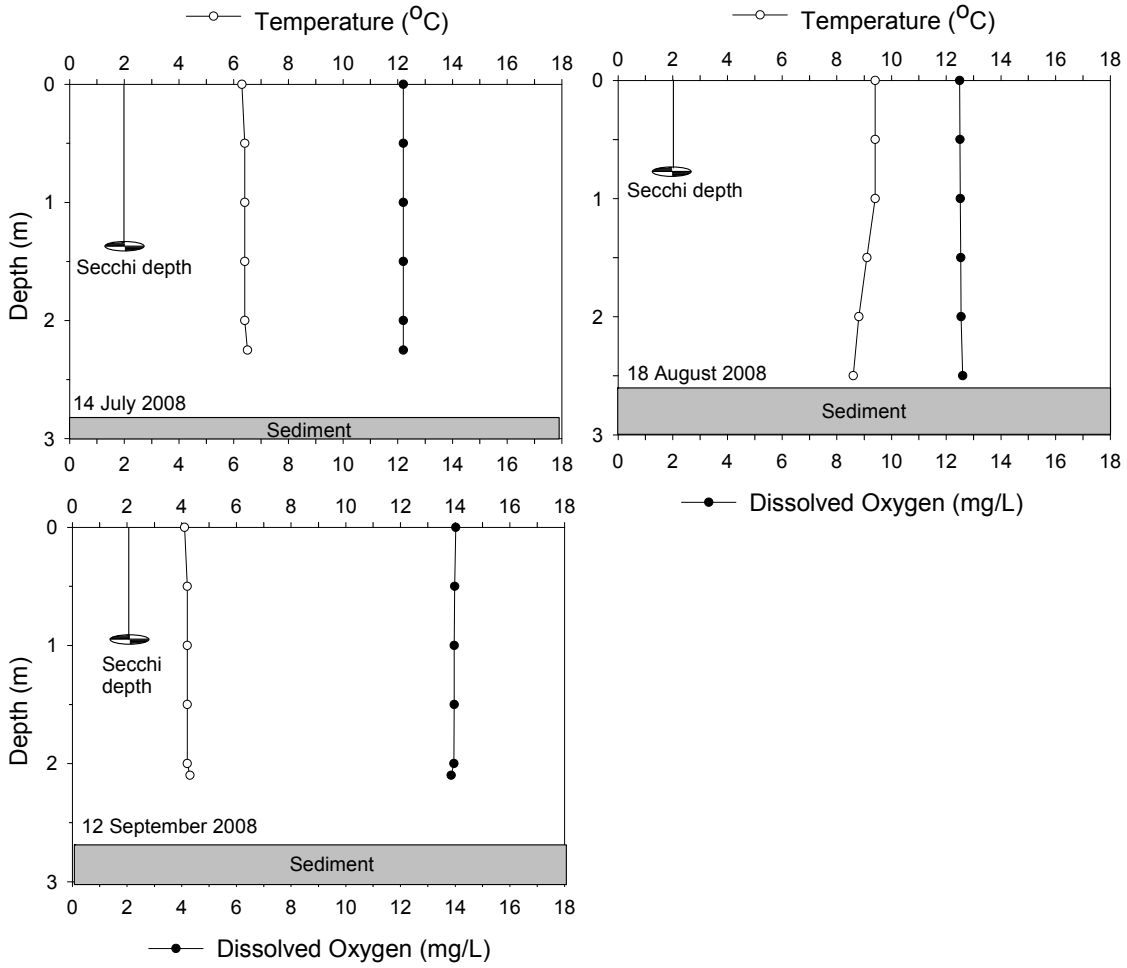


**Figure 3.9 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Little Roberts Lake, 2008**

No thermal stratification was observed during the open water season, although a slight surface layer discontinuity was evident below 1 m in August (Figure 3.9; Appendix B4). Typical seasonal temperature trends were again observed, with warmer water column temperatures in July and August compared to September (Figure 3.9). During open water conditions, the water column remained well

oxygenated (≥12.5 mg/L) (Figure 3.9; Appendix B4), with DO concentrations above the CWQG of 9.5 mg/L. DO and temperature profile data were not measured through the water column during ice-cover conditions in May, due to equipment malfunction in cold temperatures. However, as ice cover was 2 m thick (Figure 3.9; Appendix B4), it is likely that the 0.75 m of water was anoxic or nearly anoxic below the ice, similar to that described in previous years (Golder 2007, 2008c).

Total phosphorus concentrations in Little Roberts Lake ranged between 20 and 27 µg/L. Chl *a* concentrations were lower in July (3.21 µg/L) and August (4.29 µg/L) compared to September (10.4 µg/L) (Appendix B5). Based on total phosphorus concentrations, Little Roberts Lake would be classified as meso-eutrophic (CCME 2004); however, Chl *a* concentrations would place this lake within the oligo-mesotrophic category (Appendix B1) (Mitchell and Prepas 1999). This suggests that a large proportion of the total phosphorus was composed of suspended sediment and detritus. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 12% of the total nitrogen concentration (the TKN ranged from 0.33 to 0.66 mg/L).

With the exception of total aluminum, iron, and selenium, all other baseline total metal concentrations were below the CWQGs (CCME 2007a). The exceptions were as follows:

- The total aluminum concentration was higher than the CWQG of 5 µg/L (the pH was below 6.5) in May (12 µg/L) and the CWQG of 100 µg/L (the pH was above 6.5) in July (122 µg/L) (Appendix B5).
- Total iron was higher than the CWQG of 300 µg/L (CCME 2007a) and the CDWG aesthetic objective of < 300 µg/L (Health Canada 2008) in May (484 µg/L); the dissolved iron concentration (316 µg/L) also exceeded the CWQG and CDWG on this date (Appendix B5).
- Total manganese was higher than the CDWG in May (65.5 µg/L). The elevated iron and manganese, and the high proportion of soluble iron and manganese to total iron and manganese, and higher ammonia concentration compared to other lakes supports the suggestion that the under-ice water was anoxic.
- Total selenium concentrations was slightly higher than the CWQG of 1 µg/L (CCME 2007a) in August (1.1 µg/L) and September (1.1 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 was not measured in the Little Roberts Lake water samples as data on this parameter was consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season.

#### 3.3.2.3 Roberts Lake

Roberts Lake is a deep (approximately 40 m deep) freshwater lake. The southern basin where the water sampling station is located is shallow (approximately 7 m deep). The background condition is characterized by soft water, with a low to moderate sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). The pH was near neutral to alkaline (6.6 to 7.9), with slightly acidic pH occurring under ice-covered conditions. The pH was within the CWQGs (CCME 2007a) and the CDWG for human consumption (Health Canada 2008).

Concentrations of major ions were higher compared to lakes within the Boston and Madrid Project Areas, with sodium, chloride, and bicarbonate as the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 5 mg/L, with the Secchi depths ranging from 1.2 to 2.4 m (Figure 3.10).

The water column in Roberts Lake did not thermally stratify during open water conditions, and typical seasonal temperature trends were observed in the water column, with warmer water column temperatures in July and August compared to September (Figure 3.10; Appendix B4). Temperature profile data within the water column were not measured during ice-cover conditions in May due to equipment malfunction. The water column within Roberts Lake remained well oxygenated, both under ice-cover and open water conditions (Figure 3.10), with DO concentrations consistently above the CWQG of 9.5 mg/L (CCME 2007a). During under-ice conditions, the maximum DO concentration was at 3 m (14.9 mg/L) and declined to a concentration of 9.0 mg/L at 5 m (Figure 3.10). This concentration was slightly below the upper CWQG of 9.5 mg/L, but above the lower CWQG of 6.5 mg/L (CCME 2007a), which is protective of all but the early life stages of aquatic biota.

In Roberts Lake, total phosphorus concentrations ranged between 9 and 22 µg/L, with the lowest concentrations evident in May (9 to 11 µg/L) (Appendix B5). Chl *a* concentrations increased between July (2.56 µg/L) and September (6.03 µg/L). Concentrations of total phosphorus would classify Roberts Lake within the mesotrophic category (Appendix B1) (CCME 2004). However, Chl *a* concentrations are within the oligotrophic category (Appendix B1)

(Mitchell and Prepas 1990). The difference in trophic classification between the two parameters suggests that a proportion of the total phosphorus consists of suspended sediment and detritus rather than phytoplankton. Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 12% of the total nitrogen concentration (the TKN ranged from 0.27 to 0.46 mg/L); however, during under-ice conditions, higher nitrate concentrations in the top sample in May (47 µg/L) resulted in an increase in the proportion of dissolved inorganic nitrogen to total nitrogen (21%).

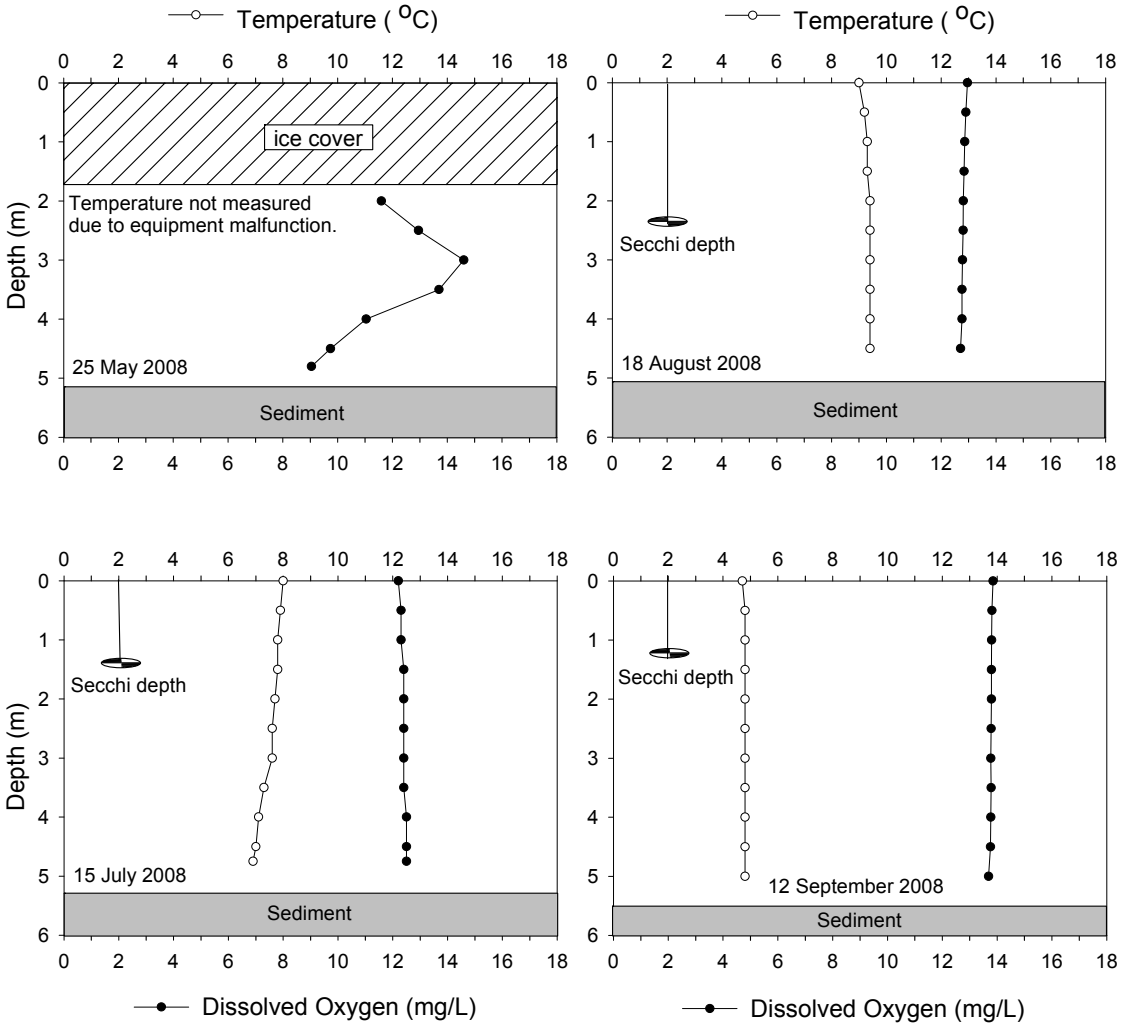


**Figure 3.10 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Roberts Lake, 2008**

No CDWGs were exceeded in Roberts Lake (Health Canada 2008). With the exception of total aluminum, cadmium, and copper, all other baseline total metal concentrations were below the CWQGs (Appendix B5). The exceptions were as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG (for pH values > 6.5) in July (top: 162 µg/L; bottom: 170 µg/L) and in September (top: 108 µg/L; bottom: 135 µg/L) (Appendix B5).
- Total cadmium was higher than the 0.015 µg/L CWQG (calculated based on a hardness of 40.4 mg $CaCO_3$/L) in September (bottom: 0.030 µg/L).
- Total copper concentrations were higher than the CWQG of 2 µg/L (CCME 2007a) in August (top: 7.3 µg/L) and September (bottom: 2.1 µg/L).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 was not measured in the Roberts Lake water samples because the data collected in 2005 showed that this parameter was consistently below the MRV. Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season.

#### 3.3.2.4 Tail Lake

Tail Lake is a clear, deep (approximately 7 m deep) freshwater lake. The baseline condition is characterized by soft water, with a low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). Higher total hardness and alkalinity values were measured in a top sample under ice-covered conditions in May, which did not persist with depth. The pH was near neutral to slightly alkaline (7.2 to 7.9), but remained within the CWQGs (CCME 2007a) and the CDWGs (Health Canada 2008).

Concentrations of major ions were higher compared to lakes within the Boston and Madrid Project Areas, with sodium, chloride, and bicarbonate being the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 3 mg/L, with the Secchi depths ranging from 2.5 to 3.9 m (Figure 3.11).

No thermal stratification was detected during the open water season (Figure 3.11; Appendix B4). Typical seasonal temperature trends were again

observed in the water column, with warmer water column temperatures in July and August compared to September. The water column in Tail Lake remained well oxygenated (> 11.5 mg/L) throughout the open-water sampling season (Figure 3.11), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a). During ice-covered conditions, DO concentrations declined slightly below 3.5 m, falling from 9.5 to 8.0 mg/L at 5 m. This concentration was below the upper CWQG of 9.5 mg/L, but above the lower CWQG of 6.5 mg/L (CCME 2007a), which is protective of all but the early life stages of aquatic biota.

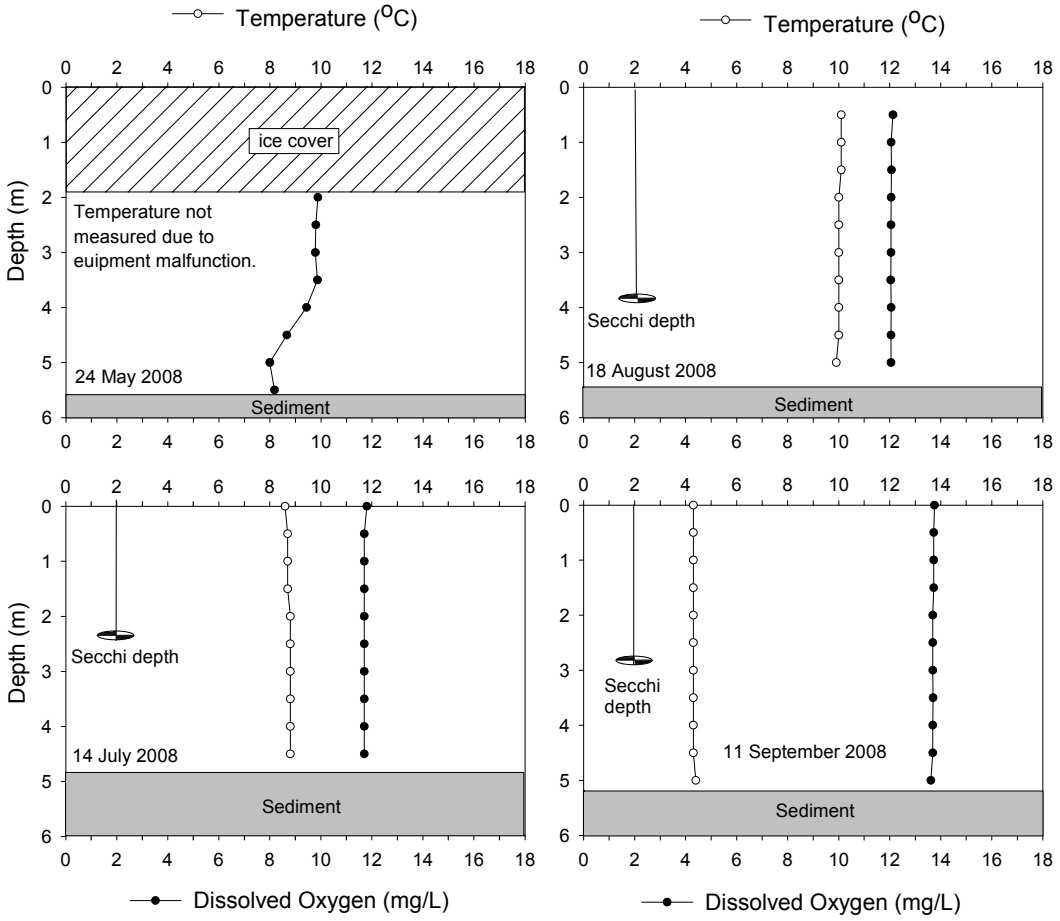


**Figure 3.11 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Tail Lake, 2008**

Total phosphorus concentrations in Tail Lake ranged between 11 and 17 µg/L. Chl *a* concentrations were lower than measured at other Doris Project Area lakes,

with lower concentrations being observed in July (0.89 µg/L) and August (0.73 µg/L) compared to September (1.33 µg/L) (Appendix B5). Based on total phosphorus concentrations, Tail Lake would be classified as mesotrophic, but the Chl *a* concentrations indicate an oligotrophic status (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). The difference in trophic classification between the two parameters suggests that a large proportion of the total phosphorus consists of suspended sediment and detritus rather than phytoplankton. Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 8% of the total nitrogen concentration (the TKN ranged from 0.27 to 0.47 mg/L).

All background total metal concentrations in Tail Lake were below applicable CWQGs (CCME 2007a) and CDWGs (Health Canada 2008). For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 was not measured again in the Tail Lake water samples as data on this parameter were consistently below the MRV in 2005 (Golder 2006a) Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season.

### 3.3.2.5 Doris Project Area Lakes Summary

The general baseline characteristics of water quality of lakes within the Doris Project Area are that they have soft water, with low to moderate sensitivity to acidification. With the exception of Tail Lake, the water clarity was generally lower compared to the lakes in the Boston Project Area.

The pH values indicated slightly acidic under ice conditions and near neutral to slightly alkaline during open water conditions. TDS concentrations indicated a low salinity, with the major ions dominated by sodium, chloride, and bicarbonate. TDS concentrations were higher than most of the lakes in the Boston Project Area, with the exception of Stickleback Lake.

No thermal stratification was evident during the open water season, with typical seasonal temperature trends observed (e.g., warmer water column temperatures occurred in July and August compared to September). The water column of each lake remained well oxygenated throughout open water conditions, with slightly lower DO generally evident in under-ice conditions.

Based on total phosphorus, the lakes in this area were classified as mesotrophic, but in some cases the Chl *a* values indicated an oligo-mesotrophic (i.e., Little Roberts Lake) or oligotrophic (i.e., Roberts and Tail lakes) status. All of the lakes in the Doris Project Area were phosphorus limited.

Baseline total metal concentrations were rarely higher than CWQGs or CDWGs in lakes in the Doris Project Area. However, concentrations of total aluminium, cadmium, copper, iron, and selenium in lakes from the Doris Project Area were higher than relevant CWQG limits for protection of aquatic life on several sampling occasions (Table 3.12). No CWQGs were exceeded in Tail Lake in 2008. During under-ice conditions, the total iron concentration was higher than the CDWG aesthetic objective in Little Roberts Lake, and pH was below the lower CDWG in Doris and Little Roberts lakes (Table 3.12). For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration. However, during under-ice conditions in the shallow lakes (e.g., Little Roberts Lake) higher metals concentrations, which comprised a high proportion of soluble fraction (e.g., iron and manganese) indicated lower oxic conditions (field measurements for DO and temperature were not available due to equipment malfunction).

In previous years, background concentrations above CWQGs were reported for total aluminum, cadmium, copper, iron, lead, nickel, mercury, and selenium on one or more sampling dates for lakes within the Doris Project Area. Background concentrations were above the CDWG aesthetic objectives for chloride, total dissolved solids, total manganese, and total iron on one or more sampling dates in the Doris Project Area lakes between 2004 and 2007 (Appendix B6).

Background radium-226 was not measured in any of the Doris Project Area lakes because historical data showed that this parameter was typically below the detection limit. Total cyanide concentrations were all below the MRV.

A summary of background water quality parameters that often naturally exceed guidelines in Doris Project Area lakes are presented in Table 3.13, which includes summary data from 2003 and 2007. These parameters include some of the specific parameters required under the MMER (see Table 6.1 in the Environmental Effects Monitoring Technical Guidance Document [Environment Canada 2002]) in the Hope Bay Belt (i.e., parameters that were typically naturally higher than CWQGs or CDWGs in lakes within the Hope Bay Belt). Overall, median results from 2008 were generally consistent with the data collected from 2003 to 2007 (Table 3.13).

## Table 3.12 Baseline Parameters above Guidelines in the Doris Project Area Lakes, 2008

| Site | Strata | Date (2008) | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) (µg/L) | | Cadmium (Total) (µg/L) | Copper (Total) (µg/L) | Iron (Total) (µg/L) | Selenium (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 5 µg/L when pH < 6.5 | CWQG 0.015 µg/L[b] | CWQG 2 µg/L | CWQG 300 µg/L | CWQG 1 µg/L |
| | | | CDWG 6.5 - 8.5[a] | | | | CDWG 5 µg/L | CDWG <1000 µg/L[a] | CDWG <300 µg/L[a] | CDWG 10 µg/L |
| Doris Lake | Top | 24-May | **6.1** | 1 | | **7.1** | | | | |
| | Bottom | 24-May | **6.1** | 2 | | **14.3** | | | | |
| | Top | 17-Aug | 8.0 | 6 | | | | | | **1.2** |
| | Bottom | 17-Aug | 8.0 | 4 | | | | | | **1.1** |
| | Top | 11-Sep | 8.0 | 5 | | | | | | |
| | Bottom | 11-Sep | 8.0 | 6 | | | | | | |
| Little Roberts Lake | Top | 25-May | **6.4** | 1 | | **12** | | | **484** | |
| | Top | 14-Jul | 7.3 | 3 | **122** | | | | | |
| | Top | 18-Aug | 7.7 | 2 | | | | | | **1.1** |
| | Top | 12-Sep | 7.8 | 3 | | | | | | **1.1** |
| Roberts Lake | Top | 15-Jul | 7.5 | 4 | **162** | | | | | |
| | Bottom | 15-Jul | 7.5 | 5 | **170** | | | | | |
| | Top | 18-Aug | 7.9 | <1 | | | | **7.3** | | **1** |
| | Top | 12-Sep | 7.8 | 2 | **108** | | | | | |
| | Bottom | 12-Sep | 7.8 | 2 | **135** | | **0.03** | **2.1** | | |

CWQG=Canadian Water Quality Guideline; CDWG=Canadian Drinking Water Guideline

[a] Aesthetic objective.

[b] Cd CWQG was adjusted for hardness for the specific site; all other sites had Cd concentrations below site-adjusted CCME guidelines.

TSS and pH are presented to help in interpretation of the values greater than the guidelines. **Bolded values** exceed the CWQG; **bolded and grey shaded values** exceeded the CDWG and CWQG.

Prepared by: JM Checked by: CC

**Table 3.13 Summary of Select Baseline Water Quality Parameters in the Doris Project Area Lakes, 2003-2008**

| Parameter | Units | 2008 | | | | | 2003-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | pH units | 16 | 7.8 | 0.7 | 6.1 | 9.2 | 40 | 6.8 | 0.6 | 5.6 | 8.2 |
| TSS | mg/L | 27 | 2 | 1.7 | <1 | 6 | 113 | 2 | 3.2 | <1 | 29 |
| DO | mg/L | 16 | 12.2 | 1.5 | 9.2 | 14.0 | 73 | 11.6 | 1.8 | 0.7 | 16.1 |
| Conductivity | µS/cm | 27 | 265 | 104 | 137 | 679 | 113 | 244 | 101 | 142 | 1160 |
| Total Phosphorous | µg/L | 27 | 20 | 8 | 9 | 34 | 116 | 19 | 11 | 6 | 70 |
| Aluminum | µg/L | 27 | 62 | 44 | 7.1 | 170 | 106 | 62 | 73 | 3.9 | 582 |
| Cadmium | µg/L | 27 | 0.0022 | 0.0056 | <0.002 | 0.0297 | 106 | <0.002 | 0.0250 | <0.002 | 0.2330 |
| Copper | µg/L | 27 | 1.5 | 1.2 | 0.97 | 7.3 | 106 | 1.5 | 0.57 | 0.61 | 5.7 |
| Mercury | ng/L | 27 | <0.6 | 0.6 | <0.6 | 3 | 101 | 0.3 | 8.4 | 0.1 | 71 |
| Selenium | µg/L | 27 | 0.7 | 0.4 | <0.1 | 1.2 | 106 | 0.6 | 0.7 | 0.1 | 6.6 |
| Zinc | µg/L | 27 | 0.7 | 1.9 | <0.1 | 9.4 | 106 | 1.8 | 3.2 | <0.1 | 20 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen.

Prepared by: DG Checked by: CC

## 3.3.3 Madrid Project Area Lakes

### 3.3.3.1 Glenn Lake

Glenn Lake is a deep (approximately 20 m deep) freshwater lake. It is characterized by naturally soft water, with a negligible sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). Sampling was limited to open water conditions at this lake in 2008.

The pH ranged from slightly alkaline to alkaline (7.6 to 8.5) (Appendix B5), and was within the CWQGs (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston and Doris Project Areas (with the exception of Little Roberts Lake), with sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from 2 to 7 mg/L, and the Secchi depths were shallow, ranging between 0.5 and 1.6 m (Figure 3.12). The highest TSS concentration and the lowest Secchi depth occurred in September and likely resulted from elevated runoff to the lake due, in part, to a rain event that occurred several days prior to the sampling event (10 September 2008).

Very slight thermal stratification was observed in August at a depth of 6 to 7 m; however, water temperature profiles were isothermic in July and September (Figure 3.9; Appendix B4). Slightly different seasonal temperature trends were observed, with warmer water column temperatures in August and September compared to July. The cooler water temperatures in July (approximately 4°C), may be reflective of later ice melt conditions in Glenn Lake. The water column remained well oxygenated (≥ 12 mg/L) throughout the open water season (Figure 3.12), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

During open water conditions, total phosphorus concentrations in Glenn Lake ranged from 8 to 27 µg/L, with concentrations increasing by a factor of three between July and September. Chl *a* concentrations were low, ranging between 1.02 and 2.41 µg/L, with peak concentrations occurring in August (Appendix B5). Based on the variation in total phosphorus concentrations, Glenn Lake would be classified as naturally oligotrophic to meso-eutrophic (Appendix B1) (CCME 2004). Chl *a* concentrations were within the oligotrophic category (Appendix B1) (Mitchell and Prepas 1990). This would suggest that the increase in total phosphorus concentrations between July and September may be associated with elevated suspended particulate matter and detritus in the lake.

Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and generally represented < 5% of the total nitrogen concentration (the TKN ranged from 0.20 to 0.24 mg/L); however, during July, higher nitrate concentrations were measured (top: 24 µg/L, and bottom: 39 µg/L), which resulted in an increase in the proportion of dissolved inorganic nitrogen to total nitrogen (13% and 18%, respectively).

With the exception of total aluminum and iron, all other baseline total metal concentrations were below the CWQGs (CCME 2007a):

- Total aluminum concentrations were higher than the CWQG of 100 µg/L (CCME 2007a) in both top and bottom samples in July, August, and September (concentrations ranged from 193 to 403 µg/L) (Appendix B5).
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in July (top: 365 µg/L; bottom: 352 µg/L) and September (top: 323 µg/L; bottom: 345 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were below the MRV (0.005 Bq/L) on all sampling occasions. Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season, although a value at the MRV was detected during under-ice conditions in May (Appendix B5).

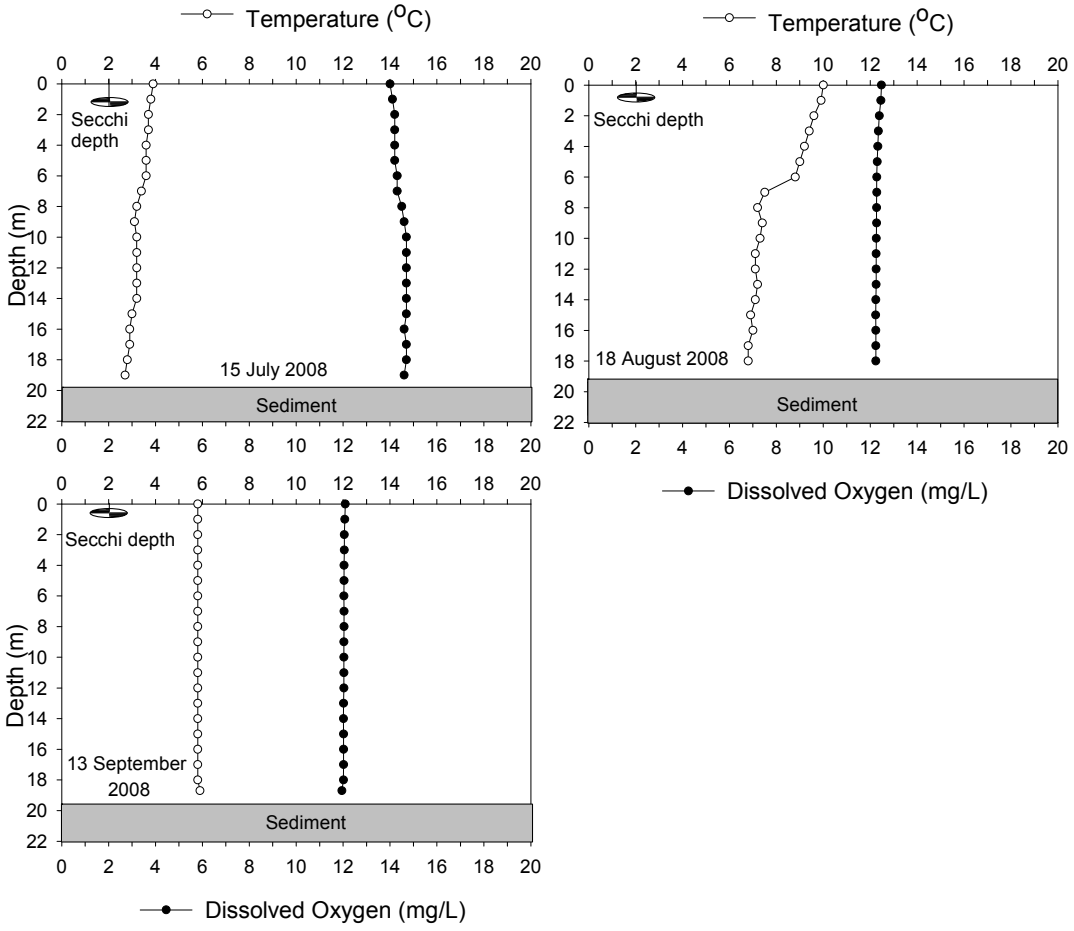


**Figure 3.12 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Glenn Lake, 2008**

### 3.3.3.2 Ogama Lake

Ogama Lake is a deep (approximately 7 m deep) freshwater lake. The background condition is characterized by naturally soft water, typically with a low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). A negligible acid sensitivity was determined during under-ice conditions, due to an increase in TDS concentration, and corresponding increase in hardness and

alkalinity (Appendix B5). The pH was near neutral to slightly alkaline (6.9 to 8.0) and within the CWQGs (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston Project Area, with the dominant ions being sodium, chloride, and bicarbonate ions (Appendix B5).

Total suspended solids concentrations during open water conditions ranged from 4 to 8 mg/L, and the corresponding Secchi depths were very shallow at (0.8 to 1.2 m) (Figure 3.13). During under ice conditions, the total suspended solids concentration was < 1 mg/L.

The water column in Ogama Lake did not thermally stratify during open water conditions, and seasonal temperature trends were again observed in the water column, with warmer water column temperatures in July and August compared to September (Figure 3.13; Appendix B4). Temperature profile data within the water column were not measured during ice-cover conditions in May due to equipment malfunction. The water column within Ogama Lake remained well oxygenated in open water conditions (Figure 3.13), with DO concentrations consistently above the CWQG of 9.5 mg/L (CCME 2007a). During under ice conditions, DO concentrations ranged from 7.8 mg/L at the top of the water column to a concentration of 6 mg/L throughout the bulk of the column. This majority of the water column under ice-conditions was below the lower CWQG of 6.5 mg/L (CCME 2007a).

Concentrations of total phosphorus in Ogama Lake ranged between 19 and 36 µg/L, with higher concentrations detected in the bottom samples in August and September. Chl *a* concentrations ranged between 2.44 and 10.22 µg/L, with peak concentrations occurring in August (Appendix B5). Based on total phosphorus concentrations, Ogama Lake would be conservatively classified as meso-eutrophic (Appendix B1) (CCME 2004); however, the range of Chl *a* concentrations indicated an oligo-mesotrophic status (Appendix B1) (Mitchell and Prepas 1990). Concentrations of all dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and generally represented < 9% of the total nitrogen concentration during open water conditions (the TKN ranged from 0.28 to 0.56 mg/L); however, during under-ice conditions, a higher nitrate concentration was measured (top: 142 µg/L, no bottom sample collected), which resulted in an increase in the proportion of dissolved inorganic nitrogen to total nitrogen (21%).

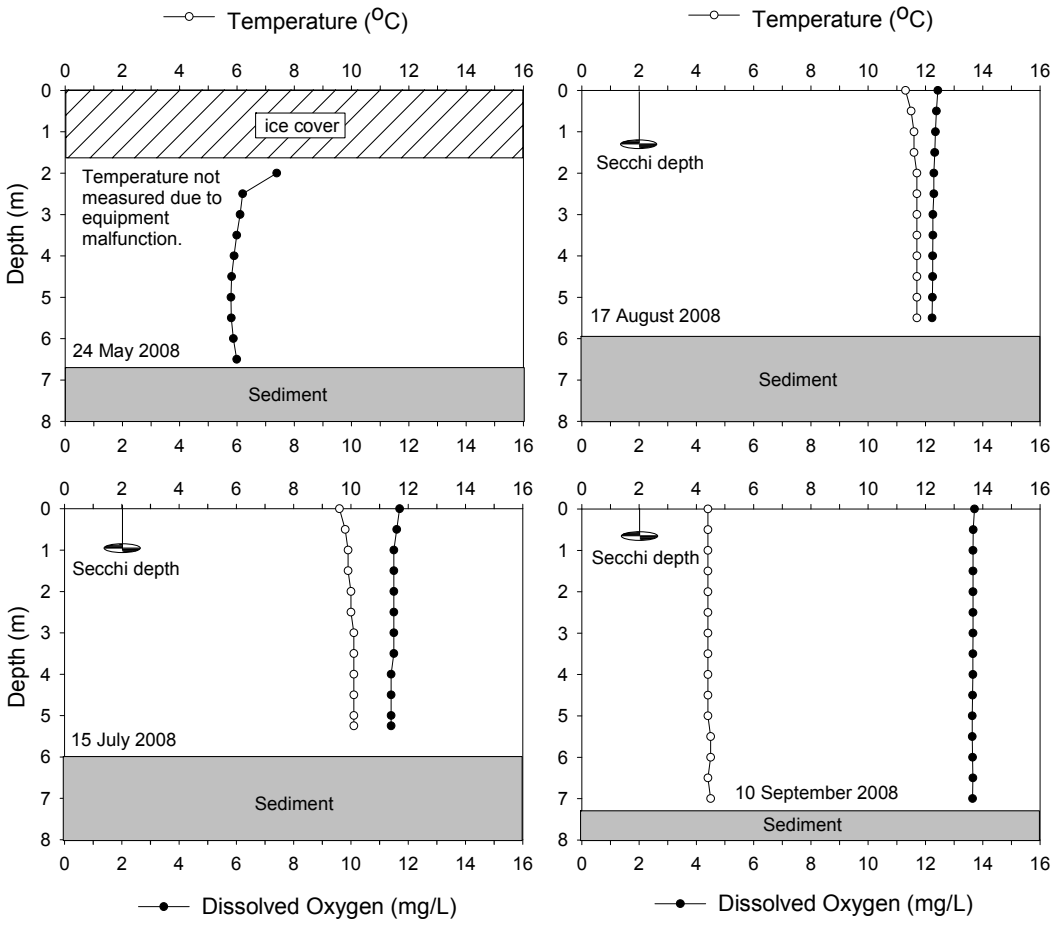


**Figure 3.13 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Ogama Lake, 2008**

With the exception of total aluminum and iron, all other background total metal concentrations were below the CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) in both top and bottom samples in July, August, and September (concentrations ranged from 193 to 403 µg/L) (Appendix B5).
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in July (top: 365 µg/L; bottom: 352 µg/L) and September (top: 323 µg/L; bottom: 345 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were below the MRV (0.005 Bq/L) on all sampling occasions. Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season, although a value at the MRV was detected during under-ice conditions in May (Appendix B5).

#### 3.3.3.3 Patch Lake

Patch Lake is a moderately deep (approximately 16 m) freshwater lake with moderate water clarity. It is characterized by naturally soft water, with a low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000).

During open water conditions, the pH in Patch Lake was slightly alkaline (7.7 to 8.0) and within the CWQGs (CCME 2007a) and the CDWGs (Health Canada 2008). During under-ice conditions, the pH was 6.6, which approached the lower limit of the CWQG. Concentrations of major ions were higher compared to lakes within the Boston Project Area, but similar to those for the Doris Project Area lakes. Sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 3 mg/L, and the Secchi depths ranged from 1.2 m to 2.8 m (Figure 3.14).

Slight thermal stratification was observed in July at approximately 10 to 11 m depth; however, DO concentrations remained high (≥ 12 mg/L) even at depth (Figure 3.14; Appendix B4). Water temperatures and DO concentrations were isothermal on other sampling occasions (Figure 3.14). Temperature profile data within the water column were not measured during ice-cover conditions in May due to equipment malfunction in cold temperatures. DO concentrations remained above the CWQG of 9.5 mg/L (CCME 2007a) for all the sampling occasions.

Total phosphorus concentrations in Patch Lake ranged between 6 and 12 µg/L. Chl *a* concentrations were low, ranging between 0.75 and 1.16 µg/L, with peak concentrations occurring in September (Appendix B5). Based on both total phosphorus and Chl *a* concentrations, Patch Lake would be conservatively classified as oligotrophic (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs and generally represented < 5% of the total nitrogen concentration (the TKN ranged from 0.21 to 0.32 mg/L); however, the under-ice bottom sample collected in May had higher nitrate and ammonia

concentrations (nitrate: 31 µg/L, and ammonia: 17 µg/L), which resulted in an increase in the proportion of dissolved inorganic nitrogen to total nitrogen (15%).

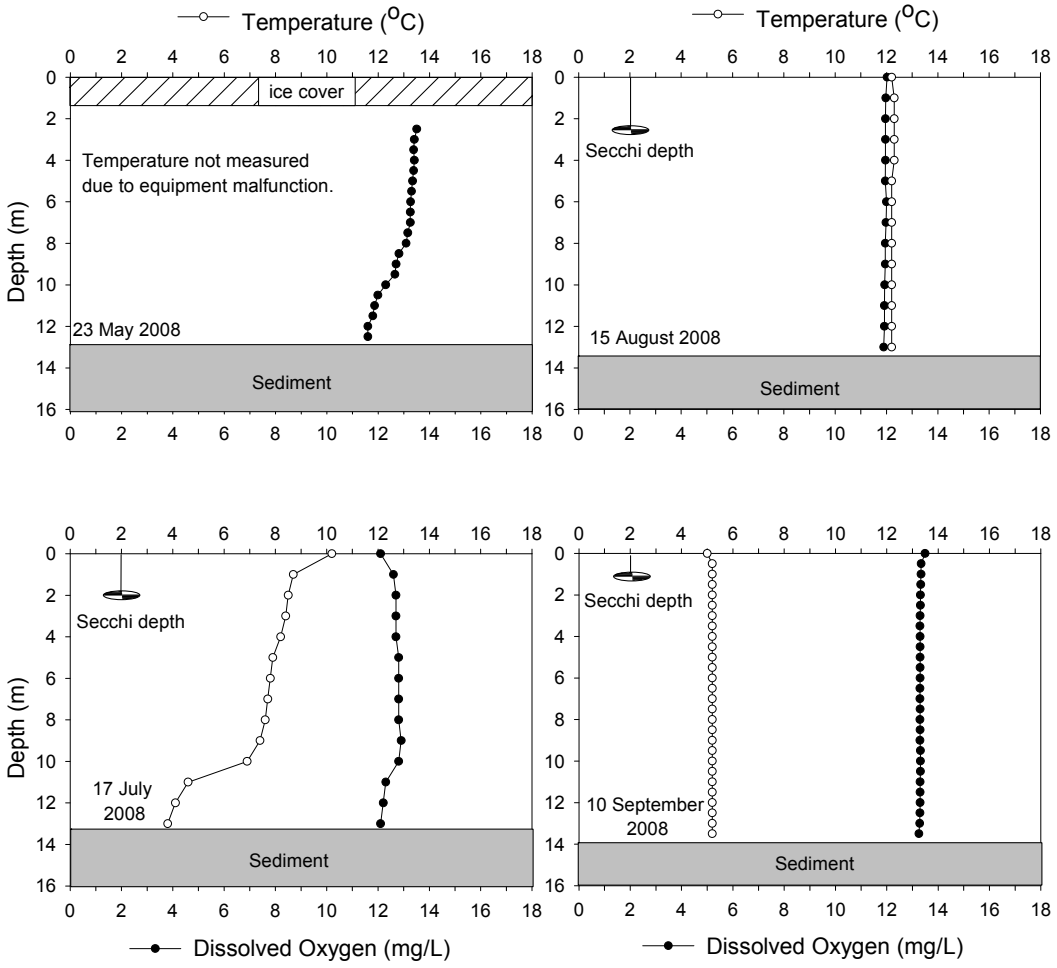


**Figure 3.14 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Patch Lake, 2008**

With the exception of total aluminum and selenium, all other baseline total metal concentrations were below the CWQGs in Patch Lake (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a) throughout the open water season ranging from 101 µg/L to 273 µg/L (Appendix B5).
- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in August (top: 1.1 µg/L; bottom: 1.5 µg/L). Dissolved

selenium also exceeded the CWQG in both the top (1.4 µg/L) and bottom (1.1 µg/L) samples (Appendix B5).

No total metals concentrations were higher than the CDWGs (Health Canada 2008). For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were generally below the MRV (0.005 Bq/L) on all sampling occasions, although a value at the MRV was detected in the bottom sample in August (Appendix B5). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) on all sampling occasions, although a value at the MRV was detected in July (Appendix B5).

#### 3.3.3.4 Pelvic Lake

Pelvic Lake is a deep (approximately 16 m deep) freshwater lake. The background conditions are characterized by naturally soft water, with a moderate to low sensitivity to acidification (Saffran and Trew 1996; Weiner 2000). Sampling was limited to open water conditions at this lake in 2008.

The pH was near neutral to slightly alkaline (7.3 to 8.0) and within the CWQG range (CCME 2007a) and the CDGW range (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston Project Area, with sodium, chloride, bicarbonate as the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from 5 to 11 mg/L (Appendix B5), which were the highest total suspended solids concentrations measured in the 2008 program. The corresponding Secchi depths were shallow, ranging between 0.5 and 1.0 m (Figure 3.15).

Thermal stratification was evident in July at a depth of approximately 8 m (Figure 3.15; Appendix B4), and seasonal temperature trends showed that warmer water column temperatures occurred in July and August compared to September (Figure 3.13; Appendix B4). An oxycline, consistent with the location of the thermocline in July, was evident with DO concentrations dropping from 12 to 3 mg/L at the bottom of the water column (Figure 3.15). Water temperature and DO profiles were isothermal in August and September (Figure 3.15). With the exception of DO concentrations below the oxycline, DO concentrations were ≥ 12 mg/L, which were above the upper CWQG of 9.5 mg/L (CCME 2007a). The DO concentration below the oxycline in July was below the

upper CWQG of 6.5 mg/L for the protection of all stages of cold freshwater aquatic life (CCME 2007a).

Total phosphorus concentrations in Pelvic Lake ranged from 32 to 102 µg/L, with the highest concentration observed in the bottom sample collected in July. Like TSS, measured total phosphorus and total nitrogen concentrations were the highest measured in any of the lakes during the 2008 baseline study. Chl *a* concentrations ranged between 6.39 and 19.48 µg/L, and the highest concentrations occurred in August and September (Appendix B5). Based on total phosphorus concentrations, Pelvic Lake would be classified as naturally eutrophic (Appendix B1) (CCME 2004), although Chl *a* concentrations indicated that Pelvic Lake has a mesotrophic status (Appendix B1) (Mitchell and Prepas 1990). This would suggest that a large proportion of the total phosphorus consists of suspended sediments or detritus rather than phytoplankton. Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 5% of the total nitrogen concentration during open water conditions (the TKN ranged from 0.45 to 0.87 mg/L).

With the exception of total aluminum and iron, all other baseline total metal concentrations were below the CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations in all samples during open water conditions were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a), with concentrations ranging from 141 µg/L to 246 µg/L (Appendix B5).
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in July (bottom sample = 1950 µg/L) and August (top sample = 329 µg/L; bottom sample = 327 µg/L). The dissolved iron concentration was also higher than the CWQG in July (bottom sample = 1260 µg/L) (Appendix B5), which likely is associated with the low oxic condition of the bottom waters resulting from stratified conditions.
- Total manganese was also higher than the 50 µg/L CDWG aesthetic objective (Health Canada 2008) in July (268 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were generally below the MRV (0.005 Bq/L) throughout open water conditions, with the exception of July (bottom: 0.008 Bq/L) and August (top: 0.007 Bq/L). Total cyanide

concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

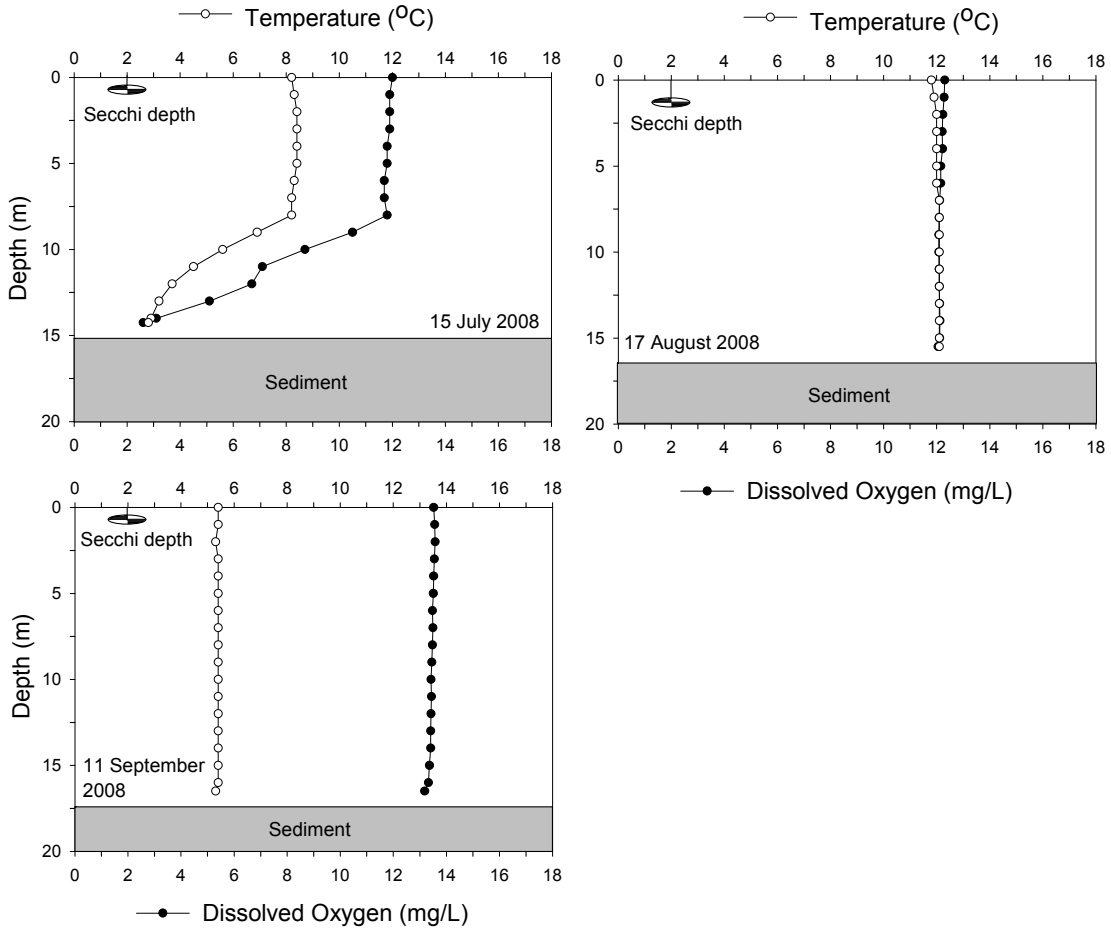


**Figure 3.15 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Pelvic Lake, 2008**

### 3.3.3.5 P.O. Lake

P.O Lake is a very shallow (approximately 3 m deep) freshwater lake. The background condition is characterized by naturally soft water, with a low acid sensitivity (Saffran and Trew 1996; Weiner 2000). Sampling was limited to open water conditions at this lake in 2008.

The pH was slightly alkaline (7.7 to 7.9) and within the CWQGs for protection of aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston Project Area, but consistent with lakes from the Doris and Madrid Project Areas. Sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from 3 to 6 mg/L, with the Secchi depths ranging from 0.4 to 1.7 m (Figure 3.16).

No thermal stratification was detected in P.O. Lake during the open water season (Figure 3.16; Appendix B4). Typical seasonal temperature trends were again observed, with warmer water column temperatures in July and August compared to September. The water column remained well oxygenated (≥ 12 mg/L) throughout the open water season, with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

Total phosphorus concentrations in P.O. Lake ranged between 12 and 22 µg/L, with the lowest total phosphorus concentration occurring in August. Chl *a* concentrations were low throughout the open water season, increasing from 0.85 µg/L in July to 1.77 µg/L in September (Appendix B5). Based on total phosphorus concentrations, P.O. Lake would be classified as naturally mesotrophic (Appendix B1) (Mitchell and Prepas 1990); however, Chl *a* concentrations indicated an oligotrophic status (Appendix B1) (CCME 2004a). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 10% of the total nitrogen concentration (the TKN ranged from 0.20 to 0.28 mg/L).

With the exception of total aluminum, chromium, iron, and selenium, all other background total metal concentrations were below the CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG L for pH conditions > 6.5 (CCME 2007a) in July (158 µg/L), August (394 µg/L), and September (923 µg/L) (Appendix B5).
- Baseline total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in September (581 µg/L) (Appendix B5).
- Total chromium concentration was higher than the 1 µg/L CWQG for sublethal toxicity for Cr(VI) (CCME 2007a) in September (1.5 µg/L).

- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in July (1.2 µg/L) and August (1.3 µg/L) (Appendix B5).

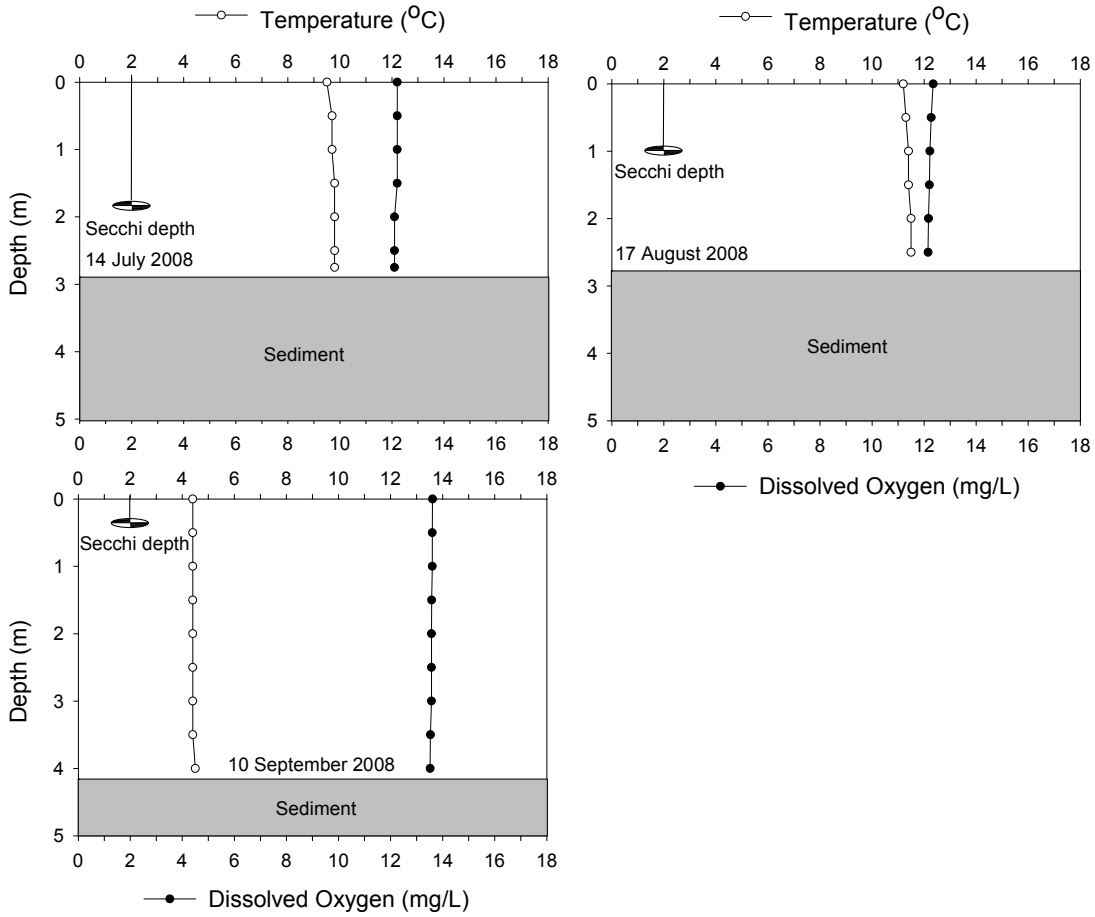


**Figure 3.16 Temperature and Dissolved Oxygen Profiles and Secchi Depths in P.O. Lake, 2008**

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration.

Background radium-226 concentrations and total cyanide were below their relevant MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

### 3.3.3.6 Windy Lake

Windy Lake is a clear, deep (approximately 18 m deep) freshwater lake. The background condition is characterized by naturally soft water, with a negligible sensitivity to acidification (Saffran and Trew 1996; Weiner 2000).

The pH was slightly alkaline (7.4 to 8.4) and within the CWQG range of 6.5 to 9.0 (CCME 2007a) and the CDWG of 6.5 to 8.5 for human consumption (Health Canada 2008). Concentrations of major ions were higher compared to the other lakes within the Madrid Project Area. Sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 1 mg/L, and the Secchi depths for Windy Lake ranged from 3.0 to 3.5 m (Figure 3.17). Windy Lake is characterized by a turquoise colour (unusual for lakes in the Hopes Bay Project Area), which is likely due to a combination of very low suspended sediment concentrations, low dissolved organic carbon, and the backscattering of light from calcium carbonate floc (consistently higher concentrations than other Boston and Madrid Project lakes) suspended in the water.

No thermal stratification was observed in Windy Lake (Figure 3.17; Appendix B4). Slightly different seasonal temperature trends were observed, with warmer water column temperatures in August and September compared to July. The cooler water temperatures in July (approximately 4°C), may be reflective of later ice melt conditions. The water column remained well oxygenated (≥ 12 mg/L) throughout the open water season (Figure 3.17), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a).

Total phosphorus concentrations in Windy Lake were low compared to other lakes in the Boston, Doris, and Madrid Project areas, ranging from 4 to 11 µg/L. Chl *a* concentrations were low in July (0.39 µg/L) and September (0.53 µg/L), but showed a substantial increase in August (8.19 µg/L) (Appendix B5). Windy Lake would be conservatively classified as oligotrophic, although the higher Chl *a* concentration observed in August would result in an oligo-mesotrophic classification (Appendix B1) (Mitchell and Prepas 1990; CCME 2004). Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 8% of the total nitrogen concentration (the TKN ranged from 0.11 to 0.15 mg/L).

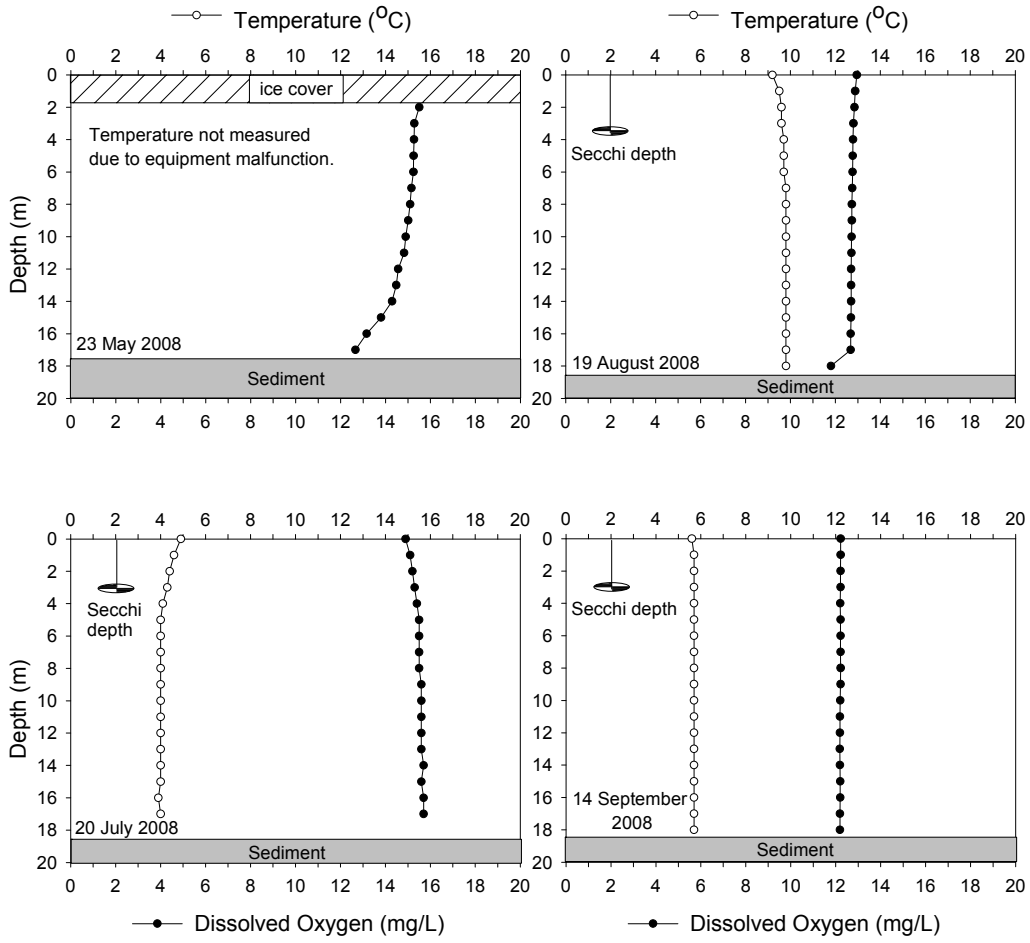


**Figure 3.17 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Windy Lake, 2008**

No trace metal concentrations were higher than CDWGs (Health Canada 2008). With the exception of total aluminum and selenium, all other background total metal concentrations were below the CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentration was higher than the 100 µg/L CWQG (CCME 2007a) for pH values > 6.5 in a bottom sample collected in August (107 µg/L).

- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in both top and bottom samples collected in August and September, ranging from 2.0 to 2.3 µg/L (Appendix B5).

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were below the MRV (0.005 Bq/L) throughout the open water season, with the exception of the bottom sample collected in July (0.007 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5)

### 3.3.3.7 Wolverine Lake

Wolverine Lake is a shallow (approximately 4.7 m deep) freshwater lake. Its background condition is characterized by naturally soft water, with a low sensitivity to acidification during open water conditions, and negligible acid sensitivity under ice-covered conditions (Saffran and Trew 1996; Weiner 2000).

The pH ranged from slightly acidic (6.7) under ice-covered conditions to slightly alkaline (7.9 to 8.3) during open water conditions; these values were within the CWQGs (CCME 2007a) and the CDWGs (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston Project Area, with the under-ice concentration higher than measured in any lake within the Hope Bay Project Area in 2008. Typically, TDS concentrations in the water column increase during under-ice conditions (Hammer 1986), with the level of TDS increases directly related to the thickness of the ice and the water depth (e.g., TDS increases will likely be more pronounced in shallow lakes). Sodium, chloride, and bicarbonate were the dominant ions in Wolverine Lake (Appendix B5). TDS and chloride concentrations were higher than CDWGs (Health Canada 2008) in May.

Total suspended solids concentrations ranged from < 1 to 5 mg/L, and the Secchi depths reached the bottom of the lake on all sampling occasions (i.e., > 2 to 2.5 m) (Figure 3.18). As noted in other lakes within the Madrid Project Area, the water in Wolverine Lake was coloured, with the true colour values being higher than CDWG of 15 TCU in May and September.

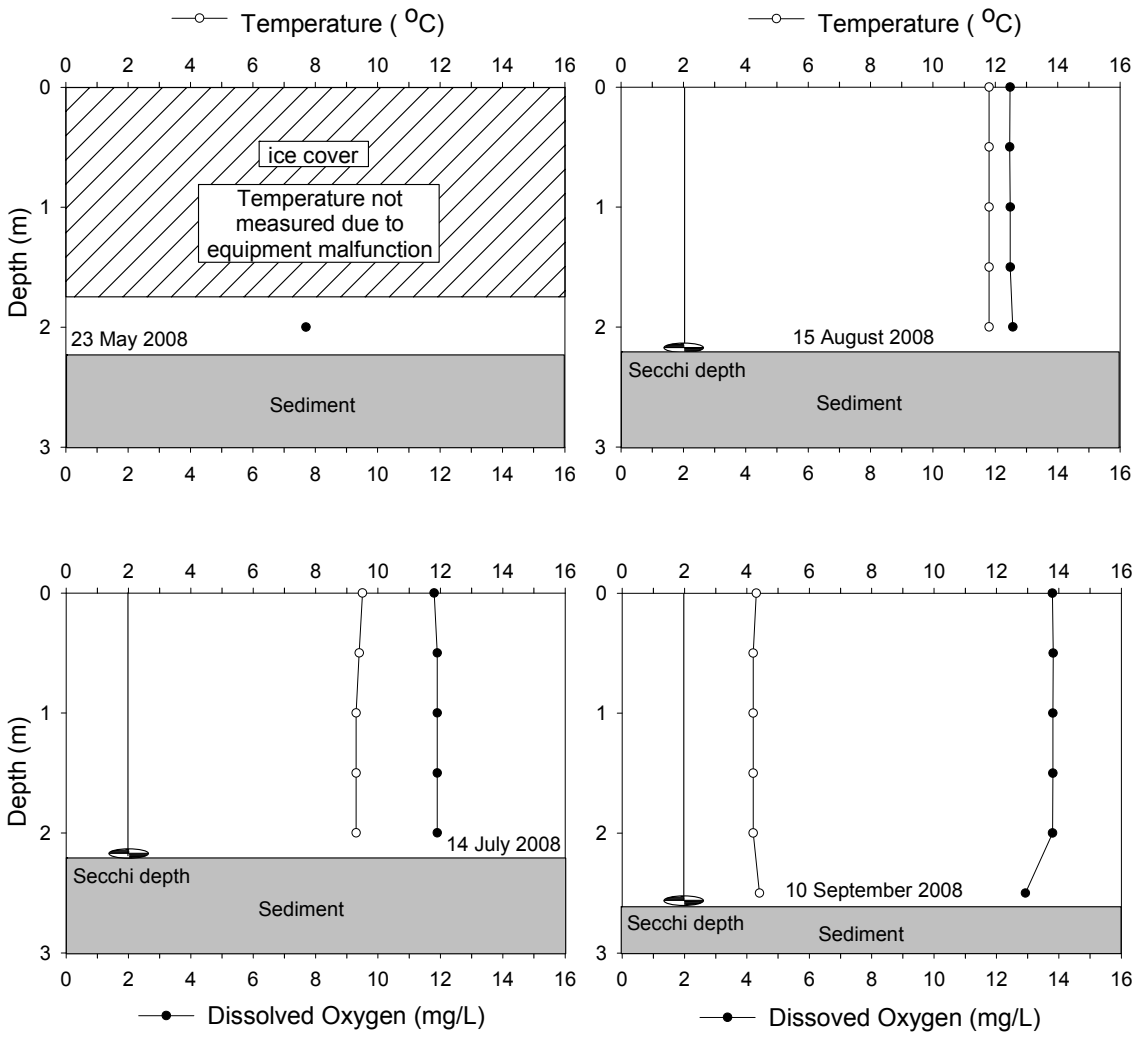


**Figure 3.18 Temperature and Dissolved Oxygen Profiles and Secchi Depths in Wolverine Lake, 2008**

No thermal stratification was evident in Wolverine Lake (Figure 3.18; Appendix B4). Typical seasonal temperature trends were observed, with warmer water column temperatures in July and August compared to September. Temperature profile data within the water column were not measured during ice-cover conditions in May due to equipment malfunction. The water column remained well oxygenated (≥ 12 mg/L) during open water conditions (Figure 3.18; Appendix B4), with DO concentrations above the CWQG of 9.5 mg/L (CCME 2007a). During under ice conditions, a DO concentration of 7.7 mg/L was measured, which was above the lower CWQG of 6.5 mg/L (CCME 2007a).

Total phosphorus concentrations ranged between 11 and 19 µg/L during open water conditions. Concentrations were higher under ice-covered conditions (35 µg/L). Concentrations of Chl *a* were similar throughout the open water season, ranging from 1.48 to 1.88 µg/L (Appendix B5). Excluding the total phosphorus concentration measured in May, Wolverine Lake would be classified as mesotrophic (Appendix B1) (CCME 2004); however, Chl *a* concentrations indicate an oligotrophic status (Appendix B1) (Mitchell and Prepas 1990). Given the shallow depth of this lake, it would not be unexpected for suspended sediments and detritus to contribute to the higher total phosphorus concentrations. Concentrations of dissolved forms of inorganic nitrogen (i.e., ammonia, nitrate, and nitrite) were below applicable CWQGs, and generally represented < 8% of the total nitrogen concentration (the TKN ranged from 0.33 to 0.88 mg/L).

With the exception of total aluminum, cadmium, iron, and selenium, all other background total metal concentrations were below CWQGs (CCME 2007a):

- During under-ice conditions, total aluminum (205 µg/L) was higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) and total iron (729 µg/L) was higher than 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008).
- Total cadmium concentration was higher than the 0.018 µg/L CWQG (calculated based on a hardness of 48.9 mg $CaCO_3$/L) (CCME 1999) in July (0.0201 µg/L).
- In August, a total selenium concentration of 1.5 µg/L was higher than the CWQG of 1.0 µg/L (CCME 2007a).
- Total manganese was higher than the CDWG aesthetic objective of < 50 µg/L (Health Canada 2008) in May (565 µg/L).

For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Background radium-226 concentrations were below the MRV (0.005 Bq/L) on all sampling occasions. Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

### 3.3.3.8 Madrid Project Area Lakes Summary

Background conditions within the Madrid Project Area characterized lakes as having fresh, soft water, with low to negligible sensitivity to acidification. Shallow lakes, such as Ogama and Wolverine, showed elevated TDS

concentrations, and associated hardness and alkalinity during under-ice conditions, which reduced the sensitivity of these lakes to acidification. Glenn and Windy lakes had a negligible sensitivity to acidification due to generally higher TDS concentrations throughout the monitoring period.

The pH values indicated slightly acidic waters during under-ice conditions and near neutral to slightly alkaline during open water conditions. TDS concentrations were higher relative to lakes in either the Boston or Doris Project Areas (an exception is Stickleback Lake in the Boston Project Area), with the major ions dominated by sodium, chloride, and bicarbonate. The Madrid Project Area's relative close proximity to the coast is likely to be the basis of the dominance of sodium and chloride relative to lakes in the Boston Project Area.

Water clarity (transparency) was more variable in lakes in the Madrid Project Area compared to the lakes in the Boston and Doris Project Areas. Clear lakes, such as Patch, Windy, and Wolverine lakes, had maximum TSS concentrations below 5 mg/L, and Secchi depths ranging up to 3.5 m. Pelvic Lake was the least transparent with highest measured TSS concentration (11 mg/L) and a shallow Secchi depth (1.0 m).

Thermal stratification was evident in several lakes during the open water season, particularly in the shallower lakes (i.e., Glenn Lake [August], Patch Lake [July], and Pelvic Lake [July]). Normal seasonal temperature trends were observed in most lakes; however, in several cases (e.g., Glenn Lake, Windy Lake) slightly atypical seasonal temperature trends were observed, with warmer water column temperatures in August and September compared to July. The cooler water temperatures in July (approximately 4°C) may be reflective of later ice melt conditions. The water column of all lakes remained well oxygenated throughout open water conditions, with slightly lower DO occuring under ice-covered conditions. During ice-covered conditions, and during periods of thermal stratification where an oxycline was evident (e.g., Pelvic Lake, July), DO concentrations were below the lower CWQG of 6.5 mg/L (CCME 2007a). In addition, Ogama Lake also had DO concentrations below 6.5 mg/L in the under-ice sample.

The trophic classification of the lakes was variable. Based on total phosphorus, the lakes were classified across a range from oligotrophic (e.g., Patch and Windy lakes), mesotrophic (e.g., P.O. and Wolverine lakes) to eutrophic (e.g., Pelvic Lake). With the exception of Patch Lake, trophic status based on Chl *a* concentrations was not generally consistent with that associated with total phosphorus concentrations, with Chl *a* indicating a lower trophic status. This inconsistency appeared to be based on higher TSS conditions, with suspended

particulate matter and detritus contributing to the higher total phosphorus concentrations. Despite the higher total phosphorus concentrations in the lakes in the Madrid Project Area, the lakes were phosphorus limited.

A number of total metal concentrations in the Doris Project Area Lakes were higher than CWQGs and CDWGs (Table 3.14). Total aluminum, iron, manganese, cadmium, copper, chromium, chloride, and selenium exceeded either one or both of the CWQGs and CDWGs. For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration, particularly when lower DO concentrations were evident, such as during under-ice conditions in the shallow lakes or below the oxycline in Pelvic Lake (e.g., iron and manganese).

In 2006 and 2007, background conditions were above CWQGs for total aluminum and selenium in all of the Madrid Project Area lakes on one or more sampling dates. Total copper and iron exceeded CWQGs on several sampling dates in all of the Madrid Project lakes, with the exception of P.O., Windy, and Wolverine lakes. Total chromium was higher than the CWQGs in one September 2007 sample in Glenn Lake. Total iron and manganese also exceeded the CDWG aesthetic objectives in several lakes (Appendix B6).

Background radium-226 and total cyanide concentrations in lakes in the Madrid Project Area were at, or below, their corresponding MRVs, with the exception of samples collected in Pelvic Lake in July (radium-226: 0.008 Bq/L) and August (0.007 Bq/L), and Windy Lake in July (radium-226: 0.007 Bq/L).

A summary of background water quality parameters that often naturally exceed guidelines in Boston Project Area lakes are presented in Table 3.15, which includes summary data from 2006 and 2007. These parameters include some of the parameters required under the MMER (Environment Canada 2002) that are naturally above guidelines in the Hope Bay Belt (i.e., parameters that were typically higher than CWQGs or CDWGs in lakes within the Hope Bay Belt). Overall, median results from 2008 were generally consistent with the range of data collected in previous years (Table 3.15).

**Table 3.14 Baseline Parameters above Guidelines in the Madrid Project Area Lakes, 2008**

| Site | Strata | Date (2008) | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) | Selenium (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 2 µg/L | CWQG 1.0 µg/L[b] | CWQG 300 µg/L | CWQG 1 µg/L |
| | | | CDWG 6.5 - 8.5[a] | | | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] | CDWG 10 µg/L |
| Glenn Lake | Top | 15-Jul | 7.6 | 3 | **250** | **2.7** | | | |
| | Bottom | 15-Jul | 7.6 | 2 | **219** | **3.0** | | | |
| | Top | 18-Aug | 8.2 | 1 | **715** | **2.9** | **1.24** | **443** | **1.4** |
| | Bottom | 18-Aug | 8.2 | 3 | **831** | **3.4** | **1.34** | **571** | **1.5** |
| | Top | 13-Sep | 8.5 | 7 | **1010** | **3.8** | **1.82** | **821** | **1.1** |
| | Bottom | 13-Sep | 8.5 | 7 | **983** | **3.5** | **1.64** | **776** | **1.1** |
| Ogama Lake | Top | 24-May | 6.9 | <1 | | | | | |
| | Top | 15-Jul | 7.5 | 4 | **200** | | | **365** | |
| | Bottom | 15-Jul | 7.5 | 4 | **193** | | | **352** | |
| | Top | 17-Aug | 8.0 | 5 | **230** | | | | **1.1** |
| | Bottom | 17-Aug | 8.0 | 2 | **217** | | | | |
| | Top | 10-Sep | 7.9 | 8 | **378** | | | **323** | |
| | Bottom | 10-Sep | 7.9 | 8 | **403** | | | **345** | |
| Patch Lake | Top | 17-Jul | 7.7 | <1 | **194** | | | | |
| | Bottom | 17-Jul | 7.7 | <1 | **104** | | | | |
| | Top | 15-Aug | 8.0 | 2 | | | | | **1.3** |
| | Bottom | 15-Aug | 8.0 | 1 | **101** | | | | **1.5** |
| | Top | 10-Sep | 7.9 | 3 | **273** | | | | **1.1** |
| | Bottom | 10-Sep | 7.9 | 4 | **240** | | | | **1.3** |

## Table 3.14 Baseline Parameters above Guidelines in the Madrid Project Area Lakes, 2008 (Cont.)

| Site | Strata | Date (2008) | Field pH<br>CWQG 6.5 - 9.0<br>CDWG 6.5 - 8.5 [a] | Total Suspended Solids (mg/L) | Total Dissolved Solids (mg/L)<br>CDWG <500 mg/L [c] | Aluminum (Total) (µg/L)<br>CWQG 100 µg/L when pH ≥ 6.5 | Cadmium (Total)<br>CWQG 0.018<br>CDWG 5 µg/L | Chloride (mg/L)<br>CDWG <250 mg/L [a] | Chromium (Total) (µg/L)<br>CWQG 1.0 µg/L [b]<br>CDWG 50 µg/L | Iron (Total) (µg/L)<br>CWQG 300 µg/L<br>CDWG <300 µg/L [a] | Manganese (Total) (µg/L)<br>CDWG <50 ug/L [a] | Selenium (Total) (µg/L)<br>CWQG 1 µg/L<br>CDWG 10 µg/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pelvic Lake | Top | 15-Jul | 7.3 | 6 | | **191** | | | | | | |
| | Bottom | 15-Jul | 7.3 | 5 | | **139** | | | | **1950** | **268** | |
| | Top | 17-Aug | 8.0 | 8 | | **141** | | | | **329** | | |
| | Bottom | 17-Aug | 8.0 | 9 | | **145** | | | | **327** | | |
| | Top | 11-Sep | 7.6 | 10 | | **239** | | | | | | |
| | Bottom | 11-Sep | 7.6 | 11 | | **246** | | | | | | |
| P.O. Lake | Top | 14-Jul | 7.7 | 3 | | **158** | | | | | | |
| | Top | 17-Aug | 7.8 | 3 | | **394** | | | | | | **1.2** |
| | Top | 10-Sep | 7.9 | 6 | | **923** | | | **1.54** | **581** | | **1.3** |
| Windy Lake | Top | 19-Aug | 8.4 | <1 | | | | | | | | **2** |
| | Bottom | 19-Aug | 8.4 | <1 | | **107** | | | | | | **2.3** |
| | Top | 14-Sep | 8.1 | <1 | | | | | | | | **1.2** |
| | Bottom | 14-Sep | 8.1 | <1 | | | | | | | | **1.3** |
| Wolverine Lake | Top | 23-May | 6.7 | 5 | **560** | **205** | | **275** | | **729** | **565** | |
| | Top | 14-Jul | 7.8 | 5 | | | **0.020** | | | | | |
| | Top | 15-Aug | 8.3 | <1 | | | | | | | | **1.5** |

CWQG=Canadian Water Quality Guideline; CDWG=Canadian Drinking Water Guideline

[a] Aesthetic objective.

[b] For Cr sublethal toxicity the CCME guideline is 1.0 µg/L, for acute toxicity the USEPA guideline is 16 µg/L; see Sub-section 3.2.4.1 in report text for details.

[c] Cd CWQG was adjusted for hardness for the specific site; all other sites had Cd concentrations below site-adjusted CCME guidelines.
TSS and pH are presented to help in interpretation of the values greater than the guidelines.
**Bolded values** exceed the CWQG; **bolded and grey shaded** values exceed the CDWG and CWQG; **bolded and blue shaded** values exceed the CDWG.

Prepared by: JM Checked by: CC

**Table 3.15 Summary of Select Baseline Water Quality Parameters in the Madrid Project Area Lakes, 2006-2008**

| Parameter | Units | 2008 | | | | | 2006-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Mean | SD | Min | Max | n | Mean | SD | Min | Max |
| pH (Field) | pH units | 25 | 7.7 | 0.5 | 6.6 | 8.5 | 46 | 7.3 | 0.7 | 5.6 | 8.6 |
| TSS | mg/L | 42 | 3.4 | 3.1 | <1 | 11 | 84 | 2.7 | 2.5 | <1 | 11 |
| DO | mg/L | 29 | 12.6 | 1.4 | 8.9 | 15.2 | 45 | 11.5 | 2.1 | 1.9 | 14.7 |
| Conductivity | µS/cm | 42 | 356 | 152 | 184 | 999 | 84 | 364 | 111 | 153 | 880 |
| Total Phosphorous | µg/L | 42 | 21 | 18 | 4 | 102 | 84 | 26 | 27 | 3 | 188 |
| Aluminum | µg/L | 42 | 243 | 264 | 4.4 | 1010 | 84 | 149 | 139 | 5.6 | 650 |
| Cadmium | µg/L | 42 | 0.0038 | 0.0040 | <0.002 | 0.0201 | 84 | 0.0031 | 0.0040 | <0.002 | 0.0172 |
| Copper | µg/L | 42 | 1.5 | 0.83 | 0.31 | 3.8 | 84 | 1.7 | 0.76 | 0.52 | 3.8 |
| Mercury | ng/L | 42 | 0.6 | 0.5 | <0.6 | 2 | 76 | 3.4 | 6.2 | <0.6 | 44 |
| Selenium | µg/L | 42 | 0.9 | 0.5 | <0.1 | 2.3 | 84 | 1.4 | 0.6 | 0.5 | 4.4 |
| Zinc | µg/L | 42 | 1.2 | 1.2 | <0.1 | 4.6 | 84 | 3.6 | 3.8 | 0.8 | 20 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen.

Prepared by: DG Checked by: CC

## 3.3.4 Summary of Water Quality in Lakes

All lakes within the Project Area were characterized by naturally fresh, soft waters. The majority of the lakes within the Boston and Doris Project Areas were moderately sensitive to acidification. Lakes within the Madrid Project Area ranged from low to negligible acidification sensitivity. The pH was typically near neutral to alkaline, although slightly acidic pH did occur under late winter ice-cover in several lakes. Sodium was the dominant ion in all lakes; chloride was also high in all lakes except Fickle Duck Lake and Reference Lake (Boston Project Area), while bicarbonate was also high in all lakes except Stickleback Lake and Doris Lake. Lakes within the Boston Project Area had the lowest concentrations of major ions, whereas lakes within the Madrid Project Area had the highest concentrations.

Thermal stratification was observed in three lakes within the Madrid Project Area, including Glenn, Patch, and Pelvic lakes. During open-water conditions, water columns in all lakes in the Hope Bay Belt remained well oxygenated, with the exception of Ogama Lake (May) and Pelvic Lake (July). In these two lakes, DO concentrations fell below the CWQG of 6.5 mg/L, which is is the lower range for the protection of all but the early life stages of cold freshwater aquatic biota (CCME 2007a). Under ice-covered conditions, DO concentrations were lower in several of the lakes, but remained above the CWQG of 6.5 mg/L.

Lakes range in trophic status from oligotrophic to meso-eutrophic based on total phosphorus concentrations. Classification of trophic status based on Chl *a* concentrations placed most lakes within the oligotrophic to oligo-mesotrophic categories. This would suggest that a proportion of the total phosphorus consists of suspended sediment and detritus rather than phytoplankton. This may be, in part, reflective of shallow water depths, which may allow wind and wave action to resuspend the surface benthic sediment layer into the water column.

Concentrations of most baseline total metals were below the applicable CWQGs (CCME 2007a); total zinc was below the CCME (2007a) guidelines for sublethal toxicity effects and the U.S.EPA (2008) guidelines for acute toxicity effects. Levels above CDWGs were recorded for a number of parameters, including iron, manganese, pH, chloride, and total dissolved solids, in one or more samples from the Hope Bay Project waterbodies. Baseline total metal concentrations that were above applicable CWQGs and CDWGs are summarized in Tables 3.16 and 3.17.

**Table 3.16 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Boston and Doris Project Areas, 2008**

| Waterbody | Parameter | Date Elevated Level Occurred (2008) |
|---|---|---|
| **Boston Project Area** | | |
| Fickle Duck Lake | total aluminum | 18-Jul, 14-Aug, 9-Sep |
| | total iron | 18-Jul[a], 14-Aug[a] |
| **Doris Project Area** | | |
| Doris Lake | pH | 24-May[a] |
| | total aluminum | 24-May |
| Little Roberts Lake | pH | 25-May[a] |
| | total aluminum | 25-May[a], 14-Jul |
| | total iron | 25-May[a] |
| | total selenium | 18-Aug, 12-Sep |
| Roberts Lake | total aluminum | 15-Jul, 12-Sep |
| | total cadmium | 12-Sep |
| | total copper | 18-Aug, 12-Sep |
| | total selenium | 17-Aug |

Notes: Jul=July; Aug=August; Sep=September
[a] CWQG and CDWG exceeded
[b] CDWG exceeded

Prepared by:SJ Checked by:AH

**Table 3.17 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Madrid Project Area, 2008**

| Waterbody | Parameter | Date Elevated Level Occurred (2008) |
|---|---|---|
| **Madrid Project Area** | | |
| Glenn Lake | total aluminum | 15-Jul, 18-Aug, 13-Sep |
| | total copper | 15-Jul, 18-Aug, 13-Sep |
| | total chromium | 18-Aug, 13-Sep |
| | total iron | 18-Aug[a], 13-Sep[a] |
| | total selenium | 18-Aug, 13-Sep |
| Ogama Lake | total aluminum | 15-Jul, 17-Aug, 10-Sep |
| | total iron | 15-Jul[a], 10-Sep[a] |
| | total selenium | 17-Aug |
| Patch Lake | total aluminum | 17-Jul, 15-Aug, 10-Sep |
| | total selenium | 15-Aug, 10-Sep |
| Pelvic Lake | total aluminum | 15-Jul, 17-Aug, 11-Sep |
| | total iron | 15-Jul[a], 17-Aug[a] |
| | total manganese | 15-Jul[b] |
| P.O. Lake | total aluminum | 14-Jul, 17-Aug, 10-Sep |
| | total chromium | 10-Sep |
| | total iron | 10-Sep[a] |
| | total selenium | 17-Aug, 10-Sep |
| Windy Lake | total aluminum | 19-Aug |
| | total selenium | 19-Aug, 14-Sep |
| Wolverine Lake | total aluminum | 23-May |
| | total cadmium | 14-Jul |
| | chloride | 23-May[b] |
| | total iron | 23-May[a] |
| | total manganese | 23-May[b] |
| | total selenium | 15-Aug |
| | TDS | 23-May[b] |

Notes: Jul = July; Aug = August; Sep = September; TDS = total dissolved solids
[a] CWQG and CDWG exceeded
[b] CDWG exceeded

Prepared by:SJ Checked by:AH

In general, the background levels of metals that were higher than relevant water quality guidelines in 2008 were also determined to be above guidelines in previous sampling programs (Appendix B6). A number of these elevated metals concentrations were slight (e.g., selenium) or considered to be associated with a sampling artifact (e.g., iron in Little Roberts Lake) associated with watershed runoff resulting from a rain event several days prior to sampling. With the exception of Roberts Lake, total aluminum concentrations listed as above guidelines were a function of lower pH (< 6.5) under ice-covered conditions, and

similar aluminum concentrations would not have been higher than the CWQG during open water conditions. For most metals, the dissolved fraction accounted for a high proportion of the total metal concentration.

In general, background radium-226 concentrations were consistently near or below the MRV in Boston and Madrid Project Area lakes; however, lakes in the Doris Project Area were not analyzed for this parameter.

## 3.4 RESULTS AND DISCUSSION: STREAMS AND RIVERS

The following section provides a summary of the water quality results for streams within the Boston, Doris, and Madrid Project areas. A detailed water quality discussion for each stream is provided under respective stream headings which focuses on general water quality characteristics, and water quality parameters that have specific guidelines or assessment criteria (e.g., TSS, pH, DO, TP, dissolved inorganic nitrogen (ammonia, nitrate and nitrite), trace metals, radium-226, and total cyanide).

All field measurements, water temperature, DO, pH, and conductivity are provided in Appendix B3. Continuous temperature data for surface waters during open water conditions is presented in the following section. Water chemistry data, including Chl *a* concentrations, are provided in Appendix B5. Water quality QA/QC data are presented in Appendix B2, and all concentrations above the CWQGs and CDWGs from 2003 to 2008 are presented in Appendix B6.

### 3.4.1 Boston Project Area Streams

#### 3.4.1.1 Aimaokatalok Inflow

Aimaokatalok Inflow is a highly coloured, freshwater stream, characterized by naturally soft water with low alkalinity and low conductivity. This stream enters Aimaokatalok Lake from the east. Sampling in this system was limited to open water conditions in 2008.

During the open water season, pH was slightly acidic to alkaline (6.6 to 8.4), with the slightly acidic pH conditions associated with the period immediately after ice-melt. These baseline pH values were within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Sodium, calcium, chloride, and bicarbonate were dominant ions, which is similar to Aimaokatalok Lake, Reference Lake, and Reference Outflow (Appendix B5).

Baseline total suspended solids concentrations ranged from 2 to 13 mg/L. The maximum concentration was measured in June, which was associated with ice-melt conditions and elevated watershed runoff and river flow conditions (Appendix B5). The total suspended solids concentrations were low (≤ 5 mg/L) throughout the rest of open water season, and were similar to other lakes and streams in the Boston Project Area.

Logged water temperature data for the Aimaokatalok Inflow showed distinct temperature maxima between mid-July and early August, with three peaks around 18°C (Figure 3.19), and the highest temperature recorded was on July 12. The minimum water temperature (3.3°C) was recorded on 8 September 2008, immediately prior to retrieval of the data logger. Aimaokatalok Inflow was well oxygenated throughout the sampling season, with all DO measurements above the 9.5 mg/L CWQG (CCME 2007a) (Appendix B3).

Total phosphorus concentrations in Aimaokatalok Inflow were similar, and ranged from 27 µg/L (June and July) to 34 µg/L (August) (Appendix B5); these concentrations were higher than those measured in Aimaokatalok Lake (Appendix B5). Based on these phosphorus concentrations, Aimaokatalok Inflow would be classified as meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were more variable than phosphorus, with TKN values ranging from 0.33 mg/L (July) to 0.70 mg/L (September). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs, and represented < 6% of the total nitrogen concentration.

With the exception of total aluminum, cadmium, chromium, and iron, all other total metal baseline concentrations were below the CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a) on all four sampling dates, with concentrations ranging from 123 to 836 µg/L (Appendix B5).
- Total iron concentrations were higher than the 300 µg/L CWQG and CDWG (CCME 2007a; Health Canada 2008) on all four sampling dates (Appendix B5), with concentrations ranging from 425 to 887 µg/L, which coincided with the elevated TSS attributed to higher flows during snow-melt conditions.

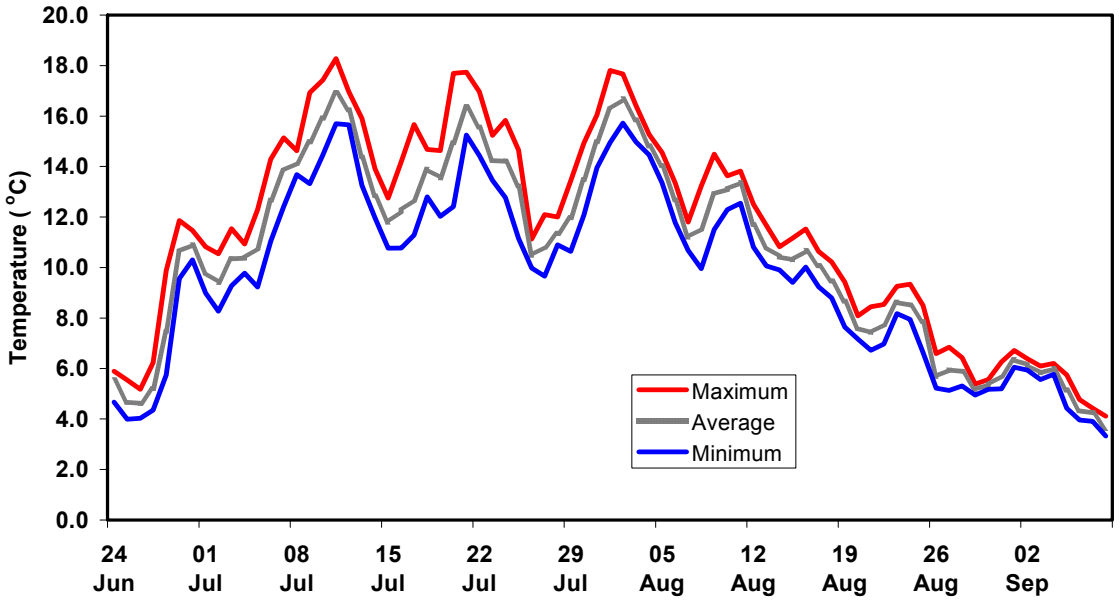


**Figure 3.19 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok Inflow, June to September, 2008**

- Total chromium concentration in June (1.3 µg/L) was slightly higher than the 1 µg/L CWQG for sublethal toxicity for Cr(VI) (CCME 2007a).
- Total cadmium concentrations were higher than the site adjusted 0.007 µg/L CWQG (calculated based on a hardness of 16.4 mg $CaCO_3$/L) in July (0.026 µg/L) (CCME 1999).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium 226 baseline concentrations were below the MRV (0.005 Bq/L) during the sampling period, with the exception of August (0.008 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

### 3.4.1.2 Aimaokatalok River

Aimaokatalok River, which enters Aimaokatalok Lake from the south, is a clear and coloured freshwater river, characterized by naturally soft water, with low alkalinity and low conductivity. The pH was near neutral to slightly alkaline (6.7 to 7.5) and within the CWQG range for the protection of freshwater aquatic life (CCME 2007a) and the CDWG range for human consumption (Health

Canada 2008). Concentrations of major ions were low; bicarbonate was the dominant ion, followed by sodium, calcium, and chloride (Appendix B5).

Aimaokatalok River had a similar clarity to Aimaokatalok Lake and Aimaokatalok Outflow, with total suspended solids concentrations ranging from < 1 to 4 mg/L (Appendix B5). The highest concentration was measured in June.

Water temperature data showed that Aimaokatalok River was similar to the temperature patterns recorded in the Aimaokatalok Inflow. Three peaks in temperature (~18°C) occurred in July, and the minimum temperature (0.2°C) was recorded in September prior to removal of the data logger (Figure 3.20). The river was well oxygenated throughout the sampling season, with all DO measurements above the CWQG of 9.5 mg/L (CCME 2007a) (Appendix B3).

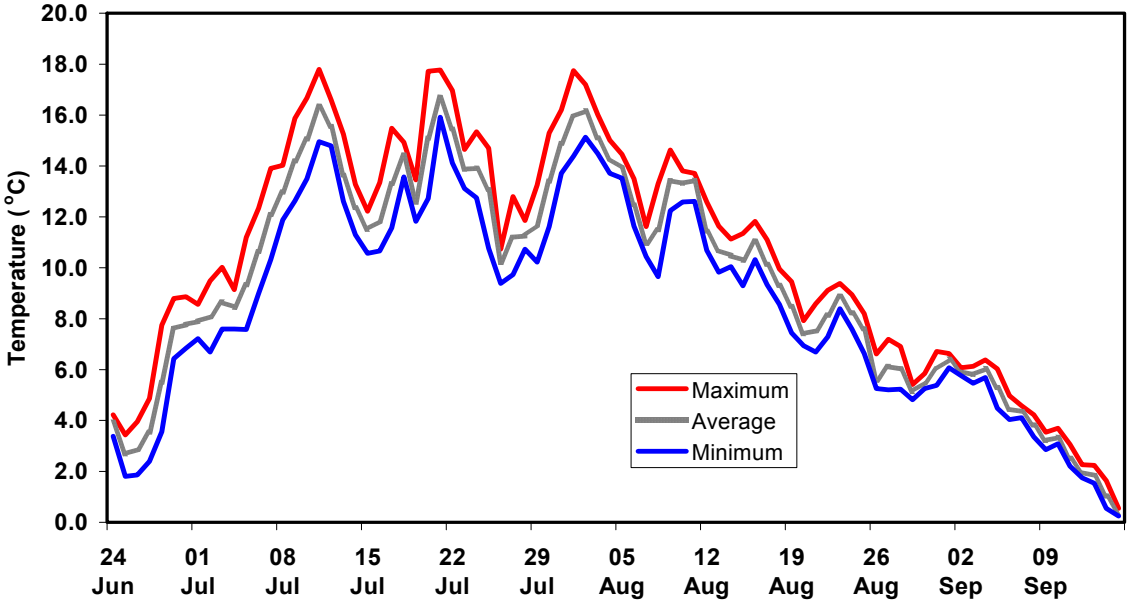


**Figure 3.20 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok River, June to September, 2008**

Total phosphorus baseline concentrations in Aimaokatalok River were between 9 and 14 µg/L, which was consistent with those measured in Aimaokatalok Lake and Aimaokatalok Outflow (Appendix B5). Aimaokatalok River is classified as an oligo-mesotrophic waterbody based on the total phosphorus concentrations (Appendix B1) (CCME 2004). Total nitrogen concentrations were also more

consistent with the range measured in Aimaokatalok Outflow, with TKN concentrations ranging from 0.23 to 0.36 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 9% of the total nitrogen concentration.

With the exception of total aluminum, copper, and iron, total metal concentrations, baseline conditions were below applicable CWQGs (CCME 2007a) (Appendix B5):

- Total aluminum was higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) in June (155 µg/L).
- Total copper was higher than the 2 µg/L CWQG in September (3.4 µg/L).
- Total iron was higher than both the 300 µg/L CWQG and CDWG in August (350 µg/L).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium 226 baseline concentrations and total cyanide were below their relevant MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout the open water season (Appendix B5).

#### 3.4.1.3 Aimaokatalok Outflow

Aimaokatalok Outflow is a clear, yet coloured freshwater stream, characterized by naturally soft water, low alkalinity, and low conductivity. Sampling was limited to open water conditions in 2008.

The pH was slightly acidic to slightly alkaline (6.6 to 7.4) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions and TDS were lower than the inflow, but as expected, sodium, calcium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Aimaokatalok Outflow had a similar clarity to Aimaokatalok Lake, with total suspended solids concentrations ranging from < 1 to 2 mg/L (Appendix B5). The highest concentration was measured in June.

Water temperature data showed that Aimaokatalok Outflow was the coolest of all Boston Project Area streams. Surface temperature patterns differed from

those measured in other streams within the Boston Project Area, with less erratic daily trends, and the peak temperatures occurring later in the open water season. August was the warmest month (maximum temperature = 12.4°C on 4 August 2008), whereas June was the coolest month (minimum temperature = 1.6°C on 26 June 2008) (Figure 3.21). Aimaokatalok Outflow was well oxygenated throughout the open water season, with all DO measurements above the 9.5 mg/L CWQG (2007a) (Appendix B3).

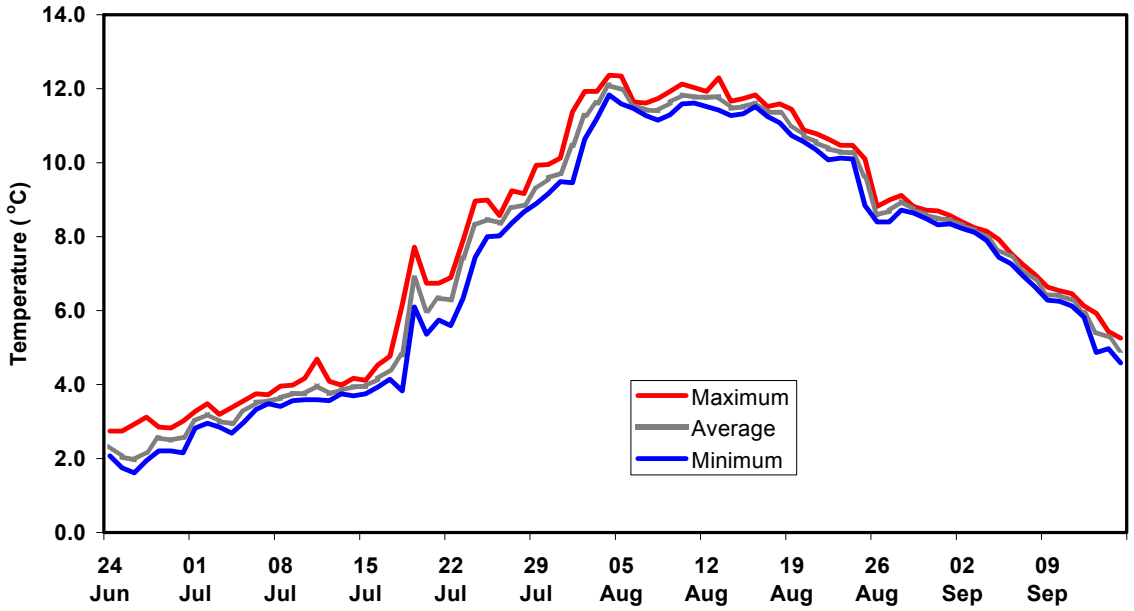


**Figure 3.21 Daily Maximum, Minimum, and Mean Water Temperatures in Aimaokatalok Outflow, June to September, 2008**

Total phosphorus concentrations in Aimaokatalok Outflow ranged from 9 to 13 µg/L (Appendix B5), which were similar to those measured in Aimaokatalok Lake. Based on these concentrations, Aimaokatalok Outflow would be classified as naturally oligotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were consistent with the range measured in Aimaokatalok Lake, with TKN concentrations ranging from 0.24 mg/L to 0.33 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs, and represented < 11% of the total nitrogen concentration.

With the exception of total aluminum, baseline total metal concentrations were below applicable CWQGs (CCME 2007a). No total metals concentrations were above relevant CDWGs (Health Canada 2008). The total aluminum concentration

measured in June (122 µg/L) was higher than 100 µg/L CWQG for pH > 6.5 (CCME 2007a) in June (122 µg/L) (Appendix B5). For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium 226 concentrations were below the MRV (0.005 Bq/L) during the sampling period, with the exception of September (0.006 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.4.1.4 Fickle Duck Outflow

Fickle Duck Outflow is a relatively clear, yet highly coloured freshwater stream, characterized by naturally soft water, with low alkalinity and low conductivity. The pH was slightly acidic to near neutral (6.4 to 7.3), with the June baseline measurement slightly below the CWQG range (CCME 2007a) and the CDWG range (Health Canada 2008) in June (pH 6.4) (Appendix B5). Concentrations of major ions were low, with sodium, calcium, chloride, and bicarbonate as the dominant ions.

The range of total suspended solids concentrations (1 to 4 mg/L) was slightly higher than Fickle Duck Lake (Appendix B5). The highest concentrations were measured in June and August.

Water temperature data showed that Fickle Duck Outflow had similar temperature patterns to Aimaokatalok Inflow and Aimaokatalok River. Three temperature peaks occurred in July (Figure 3.22). The maximum temperature was 19.3°C (11 July 2008) and the minimum temperature was 0.2°C (26 June 2008) (Figure 3.22). Fickle Duck Outflow was well oxygenated throughout the majority of the season (Appendix B3). In July, the surface DO concentration (8.1 mg/L) was below the CWQG of 9.5 mg/L for the protection of early life stages of cold water aquatic life, but above the CWQG of 6.5 mg/L for the protection of other life stages of cold water aquatic biota (CCME 2007a).

Total phosphorus concentrations in Fickle Duck Outflow ranged from 17 to 21 µg/L (Appendix B5), which is similar to concentrations measured in Fickle Duck Lake. Based on these phosphorus values, Fickle Duck Outflow would be classified as mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were also similar to the range measured in Fickle Duck Lake, with TKN concentrations ranging from 0.31 mg/L to 0.49 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were

well below applicable CWQGs, and represented < 7% of the total nitrogen concentration.

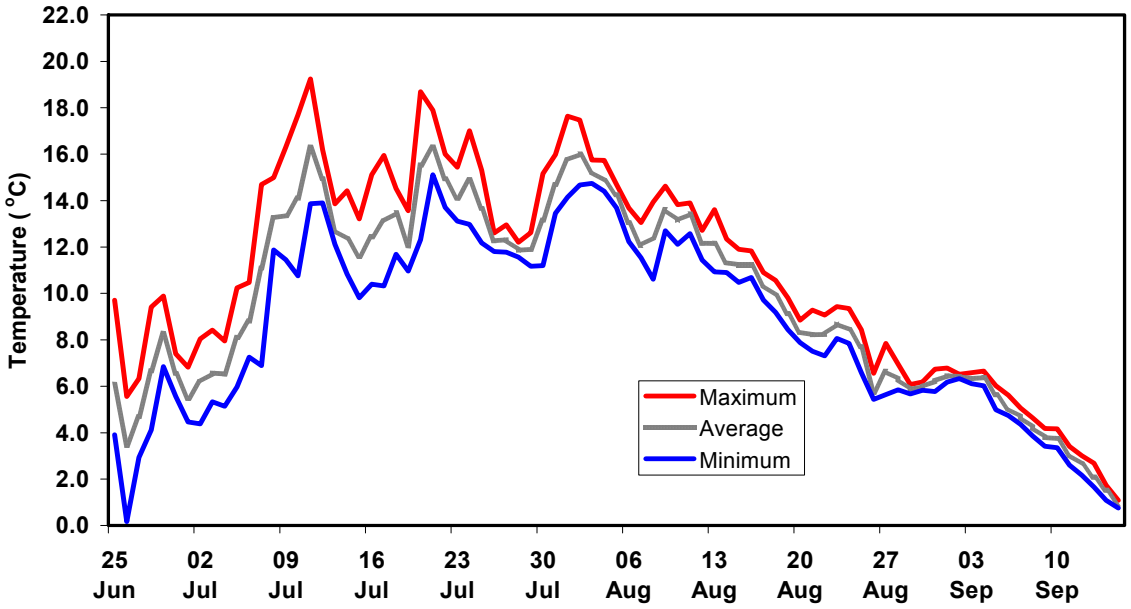


**Figure 3.22 Daily Maximum, Minimum, and Mean Water Temperatures in Fickle Duck Inflow, June to September, 2008**

With the exception of total aluminum, copper, and iron, total metal baseline concentrations were below applicable CWQGs (CCME 2007a) (Appendix B5). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG in June (327 µg/L), August (108 µg/L), and September (328 µg/L) (Appendix B5). During ice-melt conditions in June, the pH of 6.4 indicated that the lower CWQG of 5 µg/L was applicable (CCME 2007a); the concentration of dissolved aluminum was 60 µg/L, was also higher than this lower CWQG (Appendix B5).
- Total copper was higher than the 2 µg/L CWQG (CCME 2007a) in September (2.3 µg/L) (Appendix B5).
- Total iron was higher than the 300 µg/L CWQG (CCME 2007a) and the CDWG aesthetic objective (Health Canada 2008) on every sampling occasion, ranging from 366 µg/L to 540 µg/L.

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration.

Radium 226 background concentrations were below the MRV (0.005 Bq/L) during the sampling period, with the exception of July (0.008 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.4.1.5 Koignuk River

The Koignuk River, which flows south from Aimaokatalok Outflow, is a coloured freshwater river, characterized by naturally soft water, with low alkalinity and low conductivity. The pH was near neutral to slightly alkaline (7.1 to 8.0) and within the CWQG range for the protection of freshwater aquatic life (CCME 2007a) and the CDWG range for human consumption (Health Canada 2008). The concentrations of major ions and TDS were typically low, with bicarbonate being the dominant ion, followed by sodium, calcium, and chloride (Appendix B5).

Koignuk River had similar background clarity to waters in the Aimaokatalok watershed during the open water season (2 to 3 mg/L TSS) (Appendix B5). However, the highest concentration was measured in June (23 mg/L), which coincided with the ice-melt period and elevated runoff and river flows.

Logged water temperature data from the Koignuk River showed the warmest temperatures later in the open water season, between mid-July and mid-August, with a maximum of 17.0°C recorded on 2 August 2008 (Figure 3.23). The lowest mean temperature of 2.8°C was recorded on 14 September 2008 prior to removal of the data logger. Koignuk River was well oxygenated throughout the sampling season (Appendix B3), with DO concentrations consistently above the 9.5 mg/L CWQG (CCME 2007a).

Total phosphorus concentrations in Koignuk River ranged between 14 and 36 µg/L, with higher concentrations occurring in June, which coincided with the ice-melt period and more turbid conditions during elevated river flows. Based on this natural range of total phosphorus concentrations, Koignuk River is classified as meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were also more consistent than total phosphorus concentrations, with TKN concentrations ranging from 0.27 mg/L to 0.36 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 5% of the total nitrogen concentration.

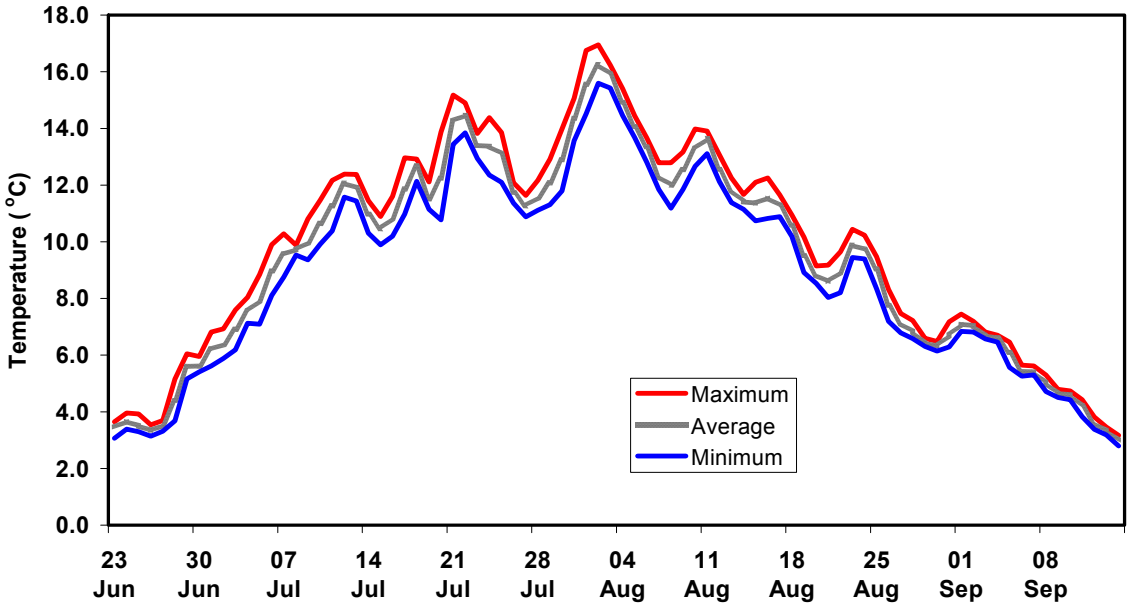


**Figure 3.23 Daily Maximum, Minimum, and Mean Water Temperatures in Koignuk River, June to September, 2008**

With the exception of total aluminum, cadmium, chromium, and iron, the remaining background total metal concentrations were below applicable CWQGs (CCME 2007a) (Appendix B5):

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) on all four sampling occasions.
- Total cadmium in September (0.156 µg/L) was higher than the site adjusted 0.007 µg/L CWQG (calculated based on a sample hardness of 17.5 mg $CaCO_3$/L) (CCME 2007a).
- Total chromium concentrations in June (2.2 µg/L) and September (3.1 µg/L) were higher than the 1 µg/L CWQG for sublethal toxicity of Cr(VI) (Appendix B5); the dissolved chromium concentration (1.2 µg/L) was also higher than the sublethal toxicity CWQG (Appendix B5).
- Total iron concentrations were higher than the 300 µg/L CWQG and the CDWG aesthetic objective in June (1160 µg/L) and September (315 µg/L) (Appendix B5).

The highest aluminum, chromium, and iron concentrations were likely related to increased suspended particulate matter resulting from elevated river flows

associated with snow melt conditions. For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration.

Radium 226 baseline concentrations and total cyanide were below their relevant MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout the open water season (Appendix B5).

### 3.4.1.6 Reference Outflow

Reference Outflow is a clear, yet coloured freshwater stream, characterized by naturally soft water, with low alkalinity and low conductivity. The pH was near neutral to slightly alkaline (6.7 to 7.5) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Consistent with other streams and rivers within the Boston Project Area, concentrations of major ions and TDS were low. Sodium, calcium, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 5 mg/L (Appendix B5). The highest concentration occurred in July.

Logged water temperature data from the Reference Outflow showed this was the warmest of all Boston Project Area streams (Figure 3.24), with the warmest temperature occuuring in July (20.1°C on 11 July 2008). The minimum temperature (2.8°C) was recorded on 9 September 2008, prior to removal of the data loggers from the stream. Reference Outflow was well oxygenated throughout the 2008 sampling season, with all DO concentrations above the 9.5 mg/L CWQG (Appendix B3).

Total phosphorus concentrations in Reference Outflow ranged from 9 to 19 µg/L, which were similar to total phosphorus concentrations in Reference Lake. Based on the natural range of total phosphorus concentrations, Reference Outflow is classified as a mesotrophic stream (Appendix B1) (CCME 2004). Total nitrogen concentrations were generally consistent with other streams in the Boston Project Area and ranged from 0.29 to 0.38 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs, and represented < 8% of the total nitrogen concentration.

With the exception of total aluminum and iron, all trace metal baseline concentrations were below applicable CWQGs. The exceptions are as follows:

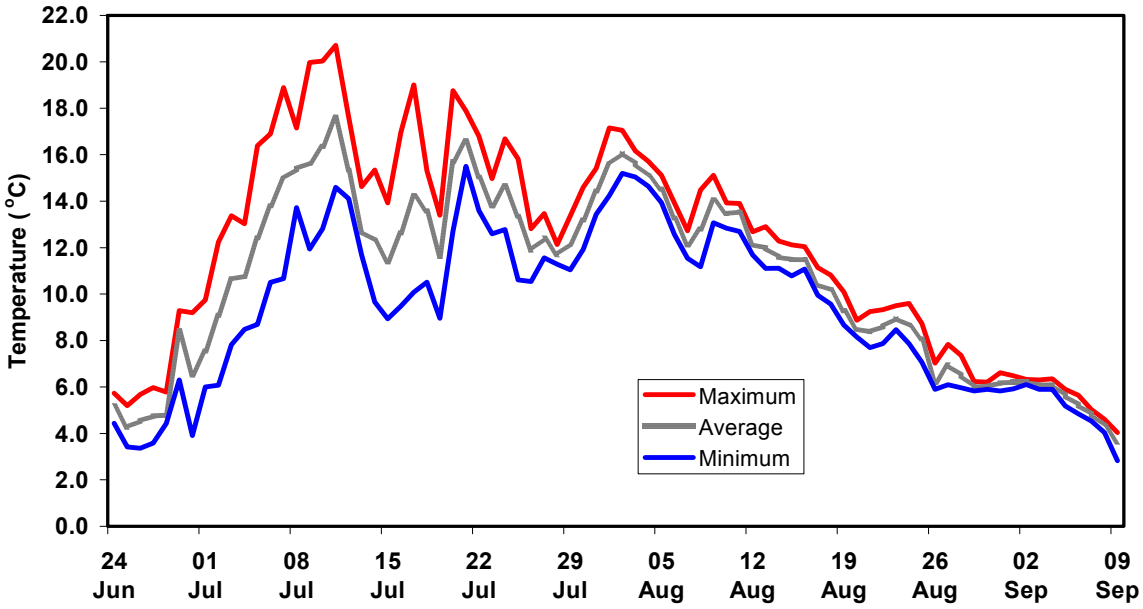


**Figure 3.24 Daily Maximum, Minimum, and Mean Water Temperatures in Reference Outflow, June to September, 2008**

- Total aluminum was higher than the 100 µg/L CWQG in June (290 µg/L) (Appendix B5) (CCME 2007a).
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and the CDWG aesthetic objective (Health Canada 2008) in June (350 µg/L) and July (366 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration.

Radium 226 baseline concentrations were higher than the MRV (0.005 Bq/L) in June and July (0.007 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

### 3.4.1.7 Stickleback Outflow

Stickleback Outflow is a clear freshwater stream, characterized by naturally soft water, with low alkalinity and low conductivity, and low colour in comparison to other streams in the Boston Project Area. The pH was near neutral to slightly alkaline (6.7 to 7.9) and within the CWQG for the protection of freshwater aquatic life (CCME 2007a) and the CDWG for human consumption (Health

Canada 2008). Concentrations of major ions and TDS were characterized as low, but were higher than other watersheds in the Boston Project Area. The dominant ion was bicarbonate, followed by sodium, calcium, and chloride (Appendix B5).

Total suspended solids concentrations ranged from < 1 to 3 mg/L (Appendix B5). The highest concentration occurred in September.

Logged water temperature data in Stickleback Outfow showed this was one of the cooler streams in the Boston Project Area (Figure 3.25). Stickleback Outflow was warmest in late-July/early-August, with maximum temperature (16.9°C) recorded on 2 August 2008, and the minimum temperature (1.0°C) recorded on 27 June 2008. Stickleback Outflow was well oxygenated throughout the majority of the open water season (Appendix B3); however, the DO concentration was below the CWQG of 9.5 mg/L in July (8.4 mg/L), but above the CWQG of 6.5 mg/L for the protection of all but the early life stages of cold water aquatic biota (CCME 2007a).

Total phosphorus concentrations in Stickleback Outflow ranged from 1 to 16 µg/L, which was similar to total phosphorus concentrations in Stickleback Lake. Based on these total phosphorus concentrations, Stickleback Outflow is classified as oligotrophic to oligo-mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were slightly more variable than other streams in the Boston Project Area and ranged from 0.17 to 0.40 mg/L. Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below the applicable CWQGs (CCME 2007a), and represented < 6% of the total nitrogen concentration.

Baseline concentrations of all metals were below applicable CWQGs (CCME 2007a) and CDWGs (Health Canada 2008). For most metals, the proportion of the dissolved fraction was high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 baseline and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L) on all sampling occasions (Appendix B5).

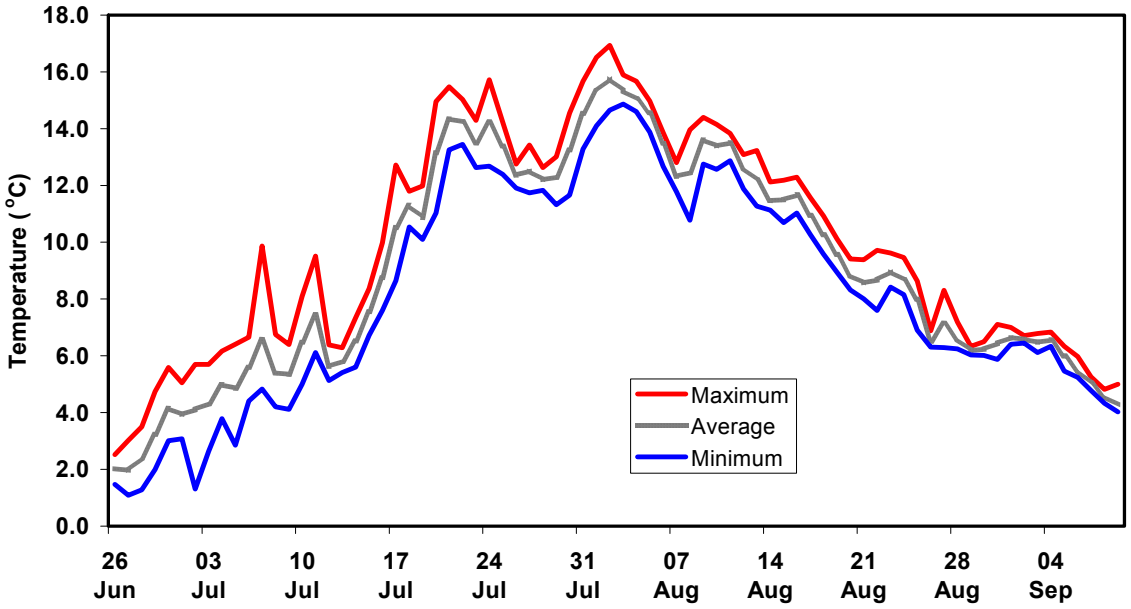


**Figure 3.25 Daily Maximum, Minimum, and Mean Water Temperatures in Stickleback Outflow, June to September, 2008**

### 3.4.1.8 Boston Project Area Streams Summary

The baseline water quality of streams within the Boston Project Area was consistent with the associated lakes in the Project Area. The streams were generally clear, yet coloured, and characterized by naturally soft waters with relatively low TDS concentrations. The range of pH values was slightly acidic to slightly alkaline, with slightly acidic pH conditions occurring in June, reflecting previous ice-covered conditions. Major ions were generally dominated by sodium, calcium, chloride, and bicarbonate, with Stickleback Outflow having the highest TDS concentrations in the area.

Logged temperatures in the streams and rivers indicated that the warmest temperatures occurred during July and August. Temperature patterns indicated multiple maximum peaks over the summer period with either early July temperature maximums (e.g., Aimaokatalok Inflow and River, Fickle Duck Outflow, Reference Outflow, and Stickleback Outflow), or maximum temperatures occurring in August (e.g., Aimaokatalok Outflow and Koignuk River). In the case of Aimaokatalok Outflow, the water temperature trend was notably even, unlike the peak nature evident in the temporal log profiles for the other streams and rivers.

The streams were generally well oxygenated over the open water season, with most of the measured DO concentrations above the 9.5 mg/L CWQG. DO concentrations below the upper DO CWQG occurred in Fickle Duck and Stickleback outflows in July, but these were above the lower 6.5 mg/L CWQG.

Phosphorus concentrations in the streams and rivers were more variable compared to levels measured in their associated lakes. Based on the total phosphorus concentrations, the streams and rivers were classified as naturally oligotrophic (e.g., Aimaokatalok Inflow), oligo-mesotrophic (e.g., Aimaokatalok River and Stickleback Outflow), mesotrophic (Fickle Duck and Reference outflows), and meso-eutrophic (Aimaokatalok Inflow and Koignuk River). The nitrogen to phosphorus ratio for streams and rivers in the Boston Project Area streams indicated phosphorus limitation. A nitrogen to phosphorus ratio of 23 to 1 is commonly considered to be the lower boundary of a phosphorus limited system (Wetzel 2001).

CWQGs and CDWGs for total metals concentrations were not generally exceeded in streams and rivers within the Boston Project Area. However, total aluminum, cadmium, chromium, copper, and iron were measured in concentrations that were higher than their applicable CWQGs and CDWGs (Table 3.18). In many instances, these exceedances occurred in June, during ice melt conditions and associated higher flows and elevated suspended particulate matter. As no substantial intensive developments are located in the Boston Project Area watersheds, the total metals concentrations were from natural catchment sources.

Radium-226 and total cyanide concentrations in streams and rivers in the Boston Project Area were generally below their applicable MRVs, with the exception of Aimaokatalok Inflow (August: 0.008 Bq/L), Aimaokatalok Outflow (September: 0.006 Bq/L), Fickle Duck Outflow (July: 0.008 Bq/L), and Reference Ouflow (June and July: 0.007 Bq/L).

A summary of select water quality parameters in the Boston Project Area streams are presented in Table 3.19, and include summary data from 2006 and 2007. These parameters include the parameters required under the MMER (Environment Canada 2002) and parameters that typically exceed CWQGs in the streams. Overall, median results from 2008 were generally consistent with the range of data collected in previous years.

**Table 3.18 Baseline Parameters above Guidelines in the Boston Project Area Streams, 2008**

| Site | Date (2008) | Field pH | Total Suspended Soilds (mg/L) | Aluminum (Total) (µg/L) | | Cadmium (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|
| | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 5 µg/L when pH < 6.5 | CWQG 0.007 µg/L[b] | CWQG 2 µg/L | CWQG 1.0 µg/L[c] | CWQG 300 µg/L |
| | | CDWG 6.5 - 8.5[a] | | | | CDWG 5 µg/L | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] |
| Aimaokatalok Inflow | 24-Jun | 6.6 | 13 | **836** | | | | **1.3** | **887** |
| | 19-Jul | 7.3 | 2 | **123** | | **0.026** | | | **517** |
| | 13-Aug | 7.2 | 4 | **196** | | | | | **643** |
| | 8-Sep | 8.4 | 5 | **302** | | | | | **425** |
| Aimaokatalok Outflow | 24-Jun | 6.6 | 2 | **122** | | | | | |
| Aimaokatalok River | 24-Jun | 6.7 | 4 | **155** | | | | | |
| | 15-Aug | 7.5 | <1 | | | | | | **350** |
| | 15-Sep | 7.3 | <1 | | | | **3.7** | | |
| Fickle Duck Outflow | 26-Jun | **6.4** | 4 | | **327** | | | | **509** |
| | 18-Jul | 6.9 | 1 | | | | | | **505** |
| | 14-Aug | 7.3 | 4 | **108** | | | | | **366** |
| | 15-Sep | 7.3 | 2 | **328** | | | **2.3** | | **540** |
| Koignuk River | 23-Jun | 7.1 | 23 | **1360** | | | | 2.2 | 1160 |
| | 17-Jul | 7.3 | 3 | **238** | | | | | |
| | 19-Aug | 7.8 | 2 | **297** | | | | | |
| | 14-Sep | 8 | 3 | **353** | | **0.165** | | **3.1** | **315** |

**Table 3.18 Baseline Parameters Above Guidelines in the Boston Project Area Streams, 2008 (cont.)**

| Site | Date (2008) | Field pH | Total Suspended Soilds (mg/L) | Aluminum (Total) (µg/L) | | Cadmium (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|
| | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 5 µg/L when pH < 6.5 | CWQG 0.007 µg/L[b] | CWQG 2 µg/L | CWQG 1.0 µg/L[c] | CWQG 300 µg/L |
| | | CDWG 6.5 - 8.5[a] | | | | CDWG 5 µg/L | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] |
| Reference Outflow | 24-Jun | 6.7 | 3 | **290** | | | | | **350** |
| | 18-Jul | 7 | 5 | | | | | | **366** |

CWQG=Canadian Water Quality Guideline; CDWG=Canadian Drinking Water Guideline

[a] Aesthetic objective.

[b] Cd CWQG was adjusted for hardness for both sites; all other sites had Cd concentrations below site-adjusted CCME guidelines; see sub-section 3.2.4.1 in report text for

[c] For Cr sublethal toxicity the CCME guideline is 1.0 µg/L, for acute toxicity the USEPA guideline is 16 µg/L; see Sub-section 3.2.4.1 in report text for details.

TSS and pH are presented to help in interpretation of the values greater than the guidelines. **Bolded values** exceed the CWQG; **bolded and grey shaded** values exceed the CDWG and the CWQG.

**Table 3.19 Summary of Select Baseline Water Quality Parameters in the Boston Project Area Streams, 2006-2008**

| Parameter | Units | 2008 | | | | | 2006-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | pH units | 28 | 7.3 | 0.5 | 6.4 | 8.4 | 53 | 6.7 | 0.4 | 6.0 | 7.8 |
| TSS | mg/L | 28 | 2 | 4.6 | <1 | 23 | 52 | 2 | 7.6 | <1 | 51 |
| DO | mg/L | 27 | 12.4 | 1.6 | 8.1 | 14.8 | 46 | 11.0 | 2.4 | 1.6 | 13.0 |
| Conductivity | µS/cm | 28 | 56 | 59 | 27 | 242 | 52 | 60 | 67 | 28 | 263 |
| Total Phosphorous | µg/L | 28 | 16 | 8 | 9 | 36 | 52 | 19 | 16 | 7 | 99 |
| Aluminum | µg/L | 28 | 104 | 284 | 13.2 | 1360 | 52 | 80 | 166 | 6.7 | 728 |
| Cadmium | µg/L | 28 | 0.0025 | 0.0309 | <0.002 | 0.1650 | 52 | 0.0029 | 0.0038 | <0.002 | 0.0236 |
| Copper | µg/L | 28 | 1.2 | 0.70 | 0.09 | 3.7 | 52 | 1.1 | 0.41 | 0.21 | 1.8 |
| Mercury | ng/L | 28 | 1.4 | 0.6 | <0.6 | 2 | 52 | <0.6 | 8.3 | <0.6 | 55 |
| Selenium | µg/L | 28 | 0.2 | 0.2 | <0.1 | 0.8 | 52 | 0.2 | 0.2 | <0.1 | 1.0 |
| Zinc | µg/L | 28 | 1.6 | 4.4 | <0.1 | 18 | 52 | 2.0 | 4.1 | 0.5 | 26 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen.

Prepared by: DG Checked by: CC

## 3.4.2 Doris Project Area Streams

### 3.4.2.1 Doris Outflow

Doris Outflow is a typically clear freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. The stream was also characterized by elevated colour during June and September. No sampling was conducted during under-ice conditions, as the stream is typically frozen to the bottom in winter.

The baseline pH was neutral to alkaline (7.0 to 8.0), and consistently within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions were higher compared to lakes within the Boston and Madrid Project Areas. Chloride was the dominant ion, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from 2 to 11 mg/L, with the highest concentration measured in June. Elevated TSS generally coincided with ice-melt conditions and elevated river and stream flows.

Logged water temperature data were limited to one data logger; the second data logger was lost during high flows in June. Surface water temperatures were warmest in July and August (Figure 3.26), with the maximum temperature

(14.4°C) recorded on 2 August 2008. The coolest temperature (2.5°C) was recorded on 25 and 26 June 2008. The maximum stream temperature was 2.5°C lower than the maximum temperature recorded in Stickleback Outflow, which was the coolest stream in the Boston Project Area. The stream was well oxygenated throughout the sampling season (Appendix B3), with all DO measurements above the 9.5 mg/L CWQG for protection of early stages of all aquatic life (CCME 2007a).

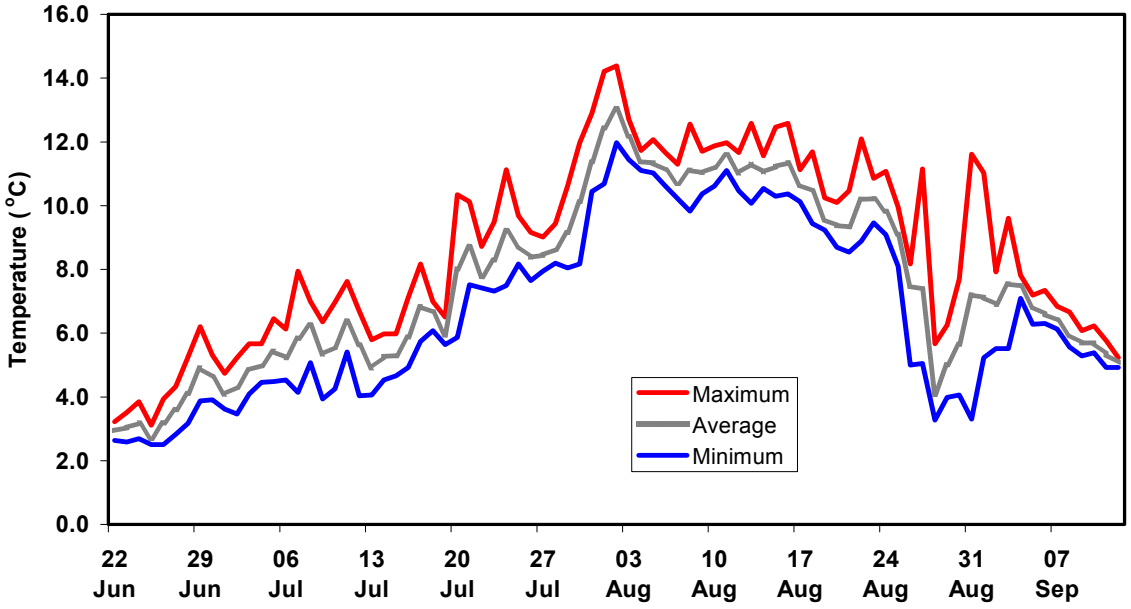


**Figure 3.26 Daily Maximum, Minimum, and Mean Water Temperatures in Doris Outflow, June to September, 2008**

Baseline total phosphorus concentrations in Doris Outflow ranged from 25 to 30 µg/L, which was similar to concentrations in Doris Lake (Appendix B5). Based on this range of phosphorus concentrations, Doris Outflow is classified as naturally meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were consistent with levels in Doris Lake, and slightly higher than the streams and rivers in the Boston Project Area (TKN ranged from 0.51 to 0.57 mg/L) (Appendix B5). Concentrations of the dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 3% of the total nitrogen concentration.

With the exception of total aluminum, copper, iron, and selenium, baseline total metal concentrations were below applicable CWQGs (CCME 2007a):

- Total aluminum (414 µg/L), copper (2.1 µg/L), iron (664 µg/L), and manganese (61.9 µg/L) concentrations were higher than their applicable CWQG and CDWGs in June. These elevated concentrations are likely associated with elevated suspended particulate matter resulting from ice melt conditions and elevated flows.
- Total iron was above the 300 µg/L CWQG and CDWG in June (664 µg/L).
- Total selenium was slightly higher than the 1 µg/L CWQG (CCME 2007a) in September (1.1 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 was not measured in the Doris Outflow water samples as baseline data on this parameter was consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.4.2.2 Little Roberts Outflow

Little Roberts Outflow is a clear freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. The stream was also characterized by naturally elevated colour during June and September. No sampling was conducted during under-ice conditions as the stream is typically frozen to the bottom in winter.

The pH was near neutral to slightly alkaline (6.8 to 7.8) and consistently within the CWQGs for the protection of aquatic life (CCME 2007a) and the CDWGs (Health Canada 2008). Concentrations of major ions were consistent with Little Roberts Lake, and similar to Doris Outflow. Sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids ranged from 2 to 8 mg/L, with the highest concentration measured in June.

Logged water temperature data are available from mid-June to early September. The data shows that the surface water temperature in Little Roberts Outflow was warmest in early August, with the maximum temperature (14.9°C) measured on 2 August 2008 (Figure 3.27) and the lowest water temperature (1.5°C) measured on 21 June 2008. Little Roberts Outflow was well oxygenated throughout the season, with DO concentrations above the 9.5 mg/L CWQG for the protection of early stages of aquatic life (CCME 2007a) (Appendix B3).

Total phosphorus concentrations in Little Roberts Outflow naturally ranged between 19 and 29 µg/L, which was similar to concentrations in Little Roberts Lake. Based on these total phosphorus concentrations, Little Roberts Outflow is classified as meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were consistent with levels in Little Roberts Lake between July and September, and slightly higher than the streams and rivers in the Boston Project Area (TKN ranged from 0.38 to 0.47 mg/L) (Appendix B5). Concentrations of the dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs (Appendix B5), and represented < 9% of the total nitrogen concentration.

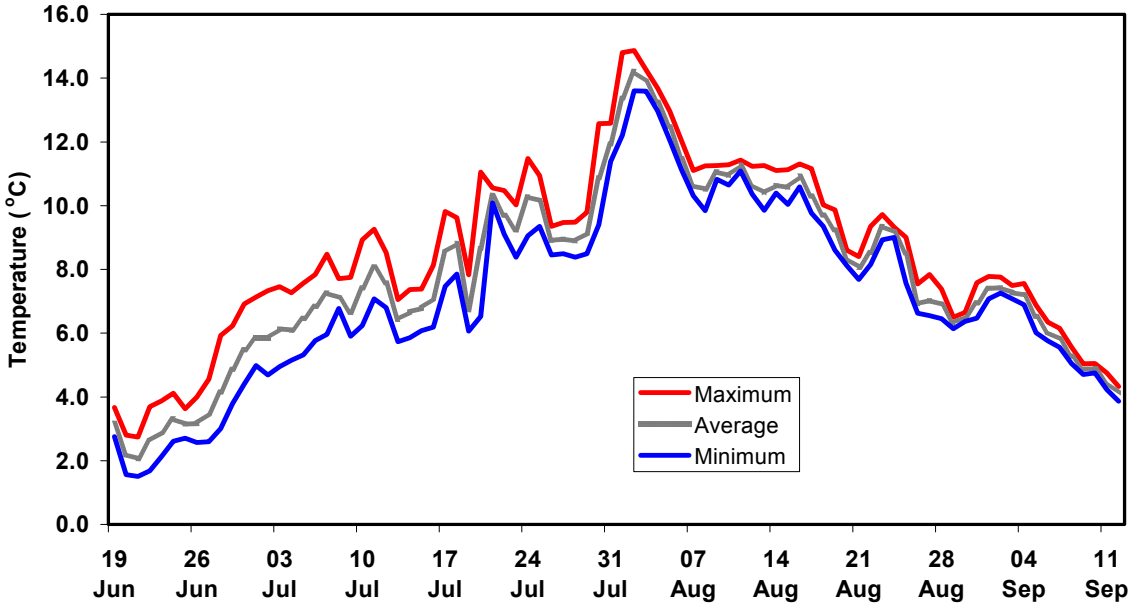


**Figure 3.27 Daily Maximum, Minimum, and Mean Water Temperatures in Little Roberts Outflow, June to September, 2008**

With the exception of total aluminum, iron, and selenium, all remaining total metals baseline concentrations were below applicable CWQGs (CCME 2007a). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a) in June (563 µg/L) and July (119 µg/L) (Appendix B5).
- Total iron was higher than the 300 µg/L CWQG and CDWG aesthetic objective in June (672 µg/L).

- Total selenium was marginally higher than the 1 µg/L CWQG in August and September (1.1 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 was not measured in the Little Roberts Outflow water samples as data on this parameter were consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

### 3.4.2.3 Roberts Outflow

Roberts Outflow is a clear freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. The stream was also characterized by elevated colour during June, July, and September. No sampling was conducted during under-ice conditions as the stream is typically frozen to the bottom in winter.

The pH was near neutral to alkaline (6.8 to 8.6) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a), but slightly above the CDWG range for human consumption (Health Canada 2008) in July (pH 8.6). Concentrations of major ions were consistent with Roberts Lake. Sodium, chloride, and bicarbonate were the dominant ions (Appendix B5).

Total suspended solids ranged from 2 to 6 mg/L, with the highest concentration measured in June.

Logged temperature data showed that Roberts Outflow was the coolest stream in the Doris Project Area (Figure 3.28). The maximum temperature was recorded on 2 August 2008 (14.4°C), and the minimum temperature (4.9°C) was recorded on 12 September 2008, immediately prior to data logger removal. Roberts Outflow was well oxygenated during open water conditions, with all DO measurements above the 9.5 mg/L CWQG (CCME 2007a) (Appendix B3).

Baseline total phosphorus concentrations in Roberts Outflow ranged from 14 to 30 µg/L, which were generally similar to those measured in Roberts Lake. The maximum concentration was measured in June when the highest TSS was measured. Based on the range of natural total phosphorus concentrations, Roberts Outflow is classified as meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were consistent with levels in Roberts Lake (TKN ranged from 0.30 to 0.41 mg/L) (Appendix B5). All of the dissolved inorganic forms of

nitrogen were also below the applicable CWQGs guidelines, and represented < 6% of the total nitrogen concentration.

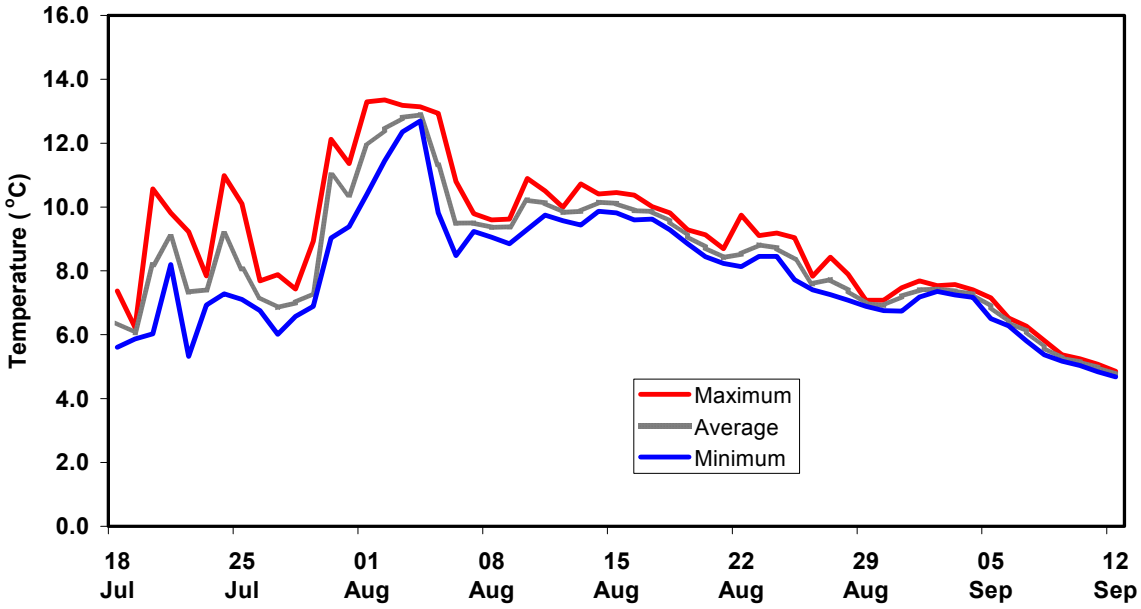


**Figure 3.28 Daily Maximum, Minimum, and Mean Water Temperatures in Roberts Outflow, June to September, 2008**

With the exception of total aluminum, chromium, and iron, all remaining total metal concentrations were below the CWQGs (Appendix B5). The exceptions are as follows:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) on three of the four sampling events in 2008, with concentrations ranging from 117 µg/L (September) to 668 µg/L (June).
- Total chromium was slightly higher than the sublethal 1 µg/L CWQG of (CCME 2007a) in June (1.1 µg/L); the dissolved chromium concentration was lower than the CWQG.
- Total iron was higher than the 300 µg/L CWQG (CCME 2007a) and the CDWG aesthetic objective of < 300 µg/L (Health Canada 2008) in June (666 µg/L) (Appendix B5). The elevated total metal concentration in June is likely associated with the elevated suspended particulate matter resulting from ice melt conditions and elevated flows.

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 was not measured in the Roberts Outflow water samples as data on this parameter was consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

#### 3.4.2.4 Tail Outflow

Tail Outflow is a small, clear freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. The stream was also characterized by elevated colour during June and September. No sampling was conducted during under-ice conditions as the stream is typically frozen to the bottom in winter.

The pH was near neutral (7.0 to 7.2) and consistently within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions and TDS measured in July and August were the lowest in streams within the Doris Project Area, but were still higher than lakes within the Boston and Madrid Project Areas. Bicarbonate was the dominant ion, followed by sodium and chloride (Appendix B5).

Logged temperature data showed that surface water temperatures in Tail Outflow were warmest between mid-July and very early August (Figure 3.29). The temperature peaked at 16.5°C on two occasions, 20 July and 1 August 2008. The coolest temperature (1.7°C) in Tail Outflow was recorded on 11 September 2008, the day the data loggers were removed. Tail Outflow had the highest maximum temperatures of the streams sampled in the Doris area. In addition, of all Doris Project Area outflows, Tail Outflow had the greatest temperature fluctuations, which were likely due to the shallow water and low discharge of this stream. Tail Outflow was generally well oxygenated during the 2008 sampling events, except in July when the DO concentration was 7.9 mg/L (Appendix B3), which was above the lower CWQG of 6.5 mg/L. All other measured DO concentrations were above the 9.5 mg/L CWQG for protection of early stages of aquatic life (CCME 2007a).

Baseline total phosphorus concentrations in Tail Outflow ranged from 7 to 15 µg/L, which was similar to concentrations in Tail Lake (Appendix B5). Based on this range of total phosphorus concentrations, which was the lowest measured in the Doris Project Area, Tail Outflow is classified as oligo-mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were also consistent with levels in Tail Lake (TKN ranged from 0.30 to 0.42 mg/L) (Appendix B5). Concentrations of the dissolved inorganic forms of nitrogen (i.e., ammonia,

nitrate, and nitrite) were well below applicable CWQGs, and represented < 4% of the total nitrogen concentration.

With the exception of total iron, total metal concentrations were below applicable CWQGs and CDWGs, with many concentrations near, or below, applicable MRVs (Appendix B5). The maximum naturally occurring total iron concentration in August (935 µg/L) exceeded the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008). The cause for this high concentration of total iron is not known.

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

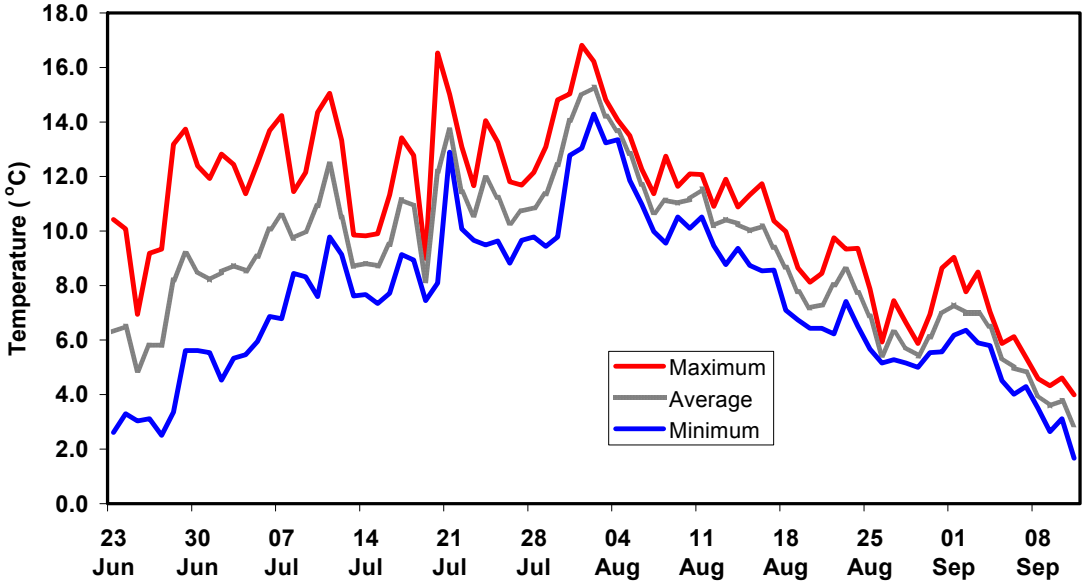


**Figure 3.29 Daily Maximum, Minimum, and Mean Water Temperatures in Tail Outflow, June to September, 2008**

Radium-226 was not measured in the Tail Outflow water samples as data on this parameter were consistently below the MRV in 2005 (Golder 2006a) Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season.

### 3.4.2.5 Doris Project Area Streams Summary

The water quality of streams within the Doris Project Area was consistent with the associated lakes in the Project Area. The streams were generally clear, although coloured, and characterized as naturally soft water with low to moderate conductivity. In many cases, the water colour was more pronounced in June and September, often exceeding CDWGs. The range of pH values was near neutral to alkaline and the major ions were generally dominated by sodium, chloride, and bicarbonate. Tail Outflow had the lowest TDS concentrations in the Project Area.

Logged temperatures in the surface waters of the streams and rivers indicated that the warmest temperatures occurred during July and August. Tail Outflow had the highest maximum temperatures of the streams sampled in the Doris Project Area and also had the greatest temperature fluctuations, which was likely due to the small size, shallow water, and low discharge of this stream.

The streams were generally well oxygenated over the open water season, with most of the measured DO concentrations naturally above the 9.5 mg/L CWQG. A DO concentration measured in Tail Outflow in July was below the upper DO CWQG of 9.5 mg/L, but above the lower 6.5 mg/L CWQG.

Baseline phosphorus concentrations in the streams and rivers were generally consistent with levels measured in associated lakes, although higher concentrations were measured in June during ice-melt conditions and associated elevated suspended particulate matter. Based on the total phosphorus concentrations, the streams in the Doris Project Area were classified as naturally oligo-mesotrophic (e.g., Tail Outflow) or meso-eutrophic (Doris Outflow, Little Roberts Outflow, Roberts Outflow). The nitrogen to phosphorus ratio for streams and rivers in the Doris Project Area streams indicated phosphorus limitation.

CWQGs and CDWGs for total metals concentrations were not generally exceeded in streams and rivers within the Boston Project Area. However, total aluminum, chromium, copper, iron, and selenium were measured in concentrations that were naturally higher than their applicable CWQGs (Table 3.20). In many instances, these exceedances occurred in June, during ice melt conditions and associated higher flows and elevated suspended particulate matter. As no significant intensive developments are located in the Doris Project Area watersheds, the total metals concentrations were from natural catchment sources.

Radium-226 was not measured in streams in the Doris Project Area as data on this parameter was consistently below the MRV in 2005 (Golder 2006a). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season.

A summary of select water quality parameters in Doris Project Area streams are presented in Table 3.21, which includes summary data from 2003 and 2007. These parameters include the parameters required under the MMER (Environment Canada 2002) and parameters that are typically above CWQGs in the streams. Overall, median results from 2008 were generally consistent with the range of data collected from 2003 to 2007.

**Table 3.20 Baseline Parameters above Guidelines in the Doris Project Area Streams, 2008**

| Site | Date (2008) | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) | Selenium (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|
| | | CWQG 6.5 - 9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 2 µg/L | CWQG 1.0 µg/L[b] | CWQG 300 µg/L | CWQG 1 µg/L |
| | | CDWG 6.5 - 8.5[a] | | | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] | CDWG 10 µg/L |
| Doris Outflow | 22-Jun | 7.0 | 11 | **414** | **2.1** | | **664** | |
| | 14-Aug | 8.0 | 5 | | | | | **1.1** |
| | 12-Sep | 7.5 | 7 | | | | | |
| Little Roberts Outflow | 19-Jun | 6.8 | 8 | **563** | | | **672** | |
| | 17-Jul | 7.7 | 3 | **119** | | | | |
| | 14-Aug | 7.8 | 3 | | | | | **1.1** |
| | 12-Sep | 7.8 | 2 | | | | | **1.1** |
| Roberts Outflow | 19-Jun | 6.8 | 6 | **668** | | **1.07** | **663** | |
| | 17-Jul | **8.6** | 2 | **133** | | | | |
| | 12-Sep | 8.1 | 3 | **117** | | | | |
| Tail Outflow | 14-Aug | 7.1 | <1 | | | | **935** | |

CWQG=Canadian Water Quality Guideline; CDWG = Canadian Drinking Water Guideline

[a] Aesthetic objective.

[b] For Cr sublethal toxicity the CCME guideline is 1.0 µg/L, for acute toxicity the USEPA guideline is 16 µg/L; see Sub-section 3.2.4.1 in report text for details.

TSS and pH are presented to help in interpretation of the values greater than the guidelines. **Bolded values** exceed the CWQG; **bolded and grey shaded** values exceed the CDWG and CWQG; **bolded and blue shaded** values exceed the CDWG.

Prepared by: JM Checked by: CC

**Table 3.21 Summary of Select Baseline Water Quality Parameters in the Doris Project Area Streams, 2003-2008**

| Parameter | Units | 2008 | | | | | 2003-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | N/A | 16 | 7.6 | 0.5 | 6.8 | 8.6 | 85 | 6.9 | 0.5 | 5.7 | 8.0 |
| TSS | mg/L | 16 | 3 | 3.3 | <1 | 11 | 127 | 2.3 | 2.9 | <1 | 25 |
| DO | mg/L | 16 | 12.7 | 1.5 | 7.9 | 14.2 | 82 | 11.0 | 1.6 | 7.2 | 13.5 |
| Conductivity | µS/cm | 16 | 266 | 49 | 145 | 306 | 127 | 244 | 53 | 147 | 449 |
| Total Phosphorous | µg/L | 16 | 22 | 9 | 7 | 40 | 128 | 18 | 10 | 2 | 50 |
| Aluminum | µg/L | 16 | 80 | 201 | 11.0 | 668 | 124 | 54 | 121 | 9.3 | 813 |
| Cadmium | µg/L | 16 | <0.002 | 0.0016 | <0.002 | 0.0070 | 124 | <0.002 | 0.0061 | <0.002 | 0.0339 |
| Copper | µg/L | 16 | 1.5 | 0.31 | 0.95 | 2.1 | 124 | 1.3 | 0.45 | 0.50 | 3.3 |
| Mercury | ng/L | 16 | 0.7 | 0.5 | <0.6 | 2 | 124 | <0.6 | 0.8 | <0.05 | 9 |
| Selenium | µg/L | 16 | 0.7 | 0.3 | <0.1 | 1.1 | 124 | 0.6 | 0.4 | <0.1 | 2.2 |
| Zinc | µg/L | 16 | 0.6 | 1.0 | <0.1 | 3.5 | 124 | 1.8 | 2.8 | 0.4 | 16 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen; N/A=not applicable

Prepared by: DG Checked by: CC

## 3.4.3 Madrid Project Area Streams

### 3.4.3.1 Glenn Outflow

Glenn Outflow is a coloured freshwater stream, characterized by naturally soft water and low to moderate conductivity during open water conditions. No sampling was conducted during under-ice conditions.

The pH was near neutral to alkaline (6.8 to 8.3) and within the CWQGs for the protection of early stages of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). As expected, concentrations of major ions and TDS were higher compared to the streams in the Boston Project Area, and similar to those in the Doris Project Area. The dominant ion was chloride, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from 1 to 8 mg/L, with the highest concentration measured in July. High levels of colour were measured throughout open water conditions, which ranged from 16 TCU (July and August) to 46 TCU (June), which were higher than the CDWG of < 15 TCU (Health Canada 2008).

Glenn Outflow was the coolest stream in the Madrid Project Area, although seasonal trends in water temperature were observed as expected (i.e., water temperature in August was warmer than in July and September) (Figure 3.30). The maximum temperature (12.9°C) was observed on 2 August 2008, and the minimum temperature (1.9°C) was observed on 20 June 2008. Glenn Outflow

was well oxygenated, with DO concentrations consistently above the 9.5 mg/L CWQG for protection of all stages of cold-water aquatic life (CCME 2007a) (Appendix B3).

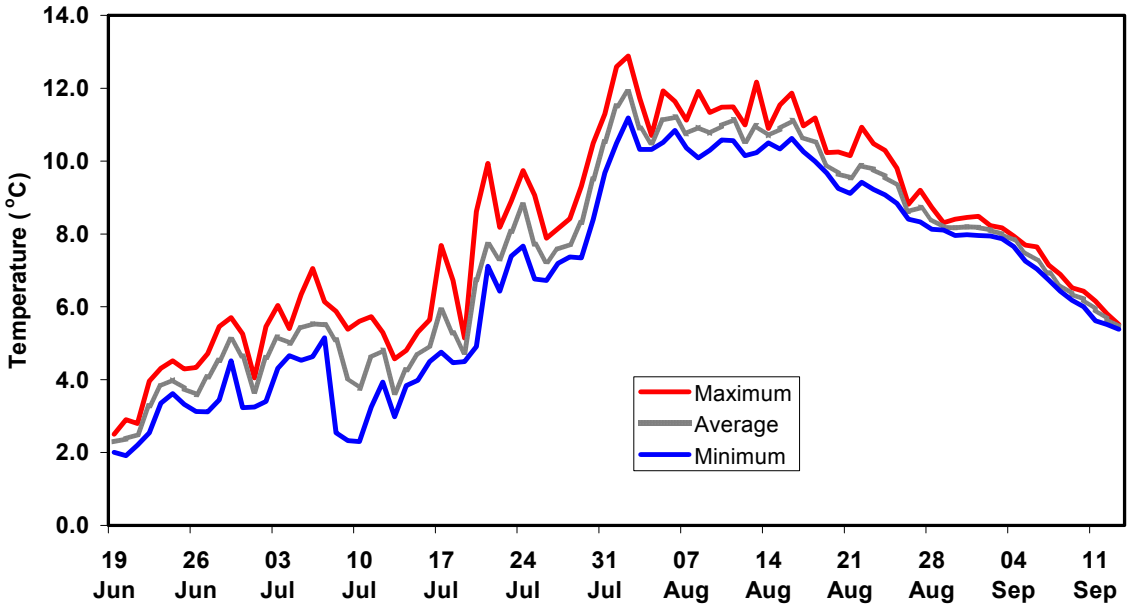


**Figure 3.30 Daily Maximum, Minimum, and Mean Water Temperatures in Glenn Outflow, June to September, 2008**

Total phosphorus concentrations in Glenn Outflow were similar to Glenn Lake, ranging from 15 to 21 µg/L (Appendix B5). Based on these phosphorus levels, Glenn Outflow is classified as naturally mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were similar to levels measured in Glenn Lake (TKN ranged from 0.24 to 0.40 mg/L) (Appendix B5). Concentrations of the dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 7% of the total nitrogen concentration.

Glenn Outflow had the greatest number of CWQG exceedences for total metals of all streams within the Madrid Project Area. Baseline concentrations of total aluminum, chromium, copper, iron, and selenium were higher than applicable CWQGs, which was consistent with the metals assessment for Glenn Lake. Total iron was also above the CDWGs for human consumption. Remaining total metal concentrations were below applicable CWQGs (CCME 2007a) and CDWGs (Health Canada 2008). Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations were higher than the CWQG of 100 µg/L for pH values > 6.5 (CCME 2007a) on all four sampling dates, with concentrations ranging between 267 µg/L (June) and 858 µg/L (September) (Appendix B5). In August, the dissolved aluminum concentration (107 µg/L) exceeded the CWQG (Appendix B5).
- Total chromium concentrations were higher than the sublethal toxicity 1 µg/L CWQG for Cr(VI) (CCME 2007a) in July (1.2 µg/L) and September (1.5 µg/L) (Appendix B5). These exceedences are likely to be very conservative because the guideline refers to Cr(VI) and not total chromium (CCME 2007a). The acute toxicity guideline (USEPA 2008) was not exceeded on any occasion.
- Total copper concentrations were higher than the 2 µg/L CWQG of (CCME 2007a) on all four sampling dates, with concentrations ranging between 2.4 µg/L (June) and 3.5 µg/L (September) (Appendix B5). Dissolved copper concentrations were also higher than the CWGQ on all four dates, with concentrations ranging from 2.5 µg/L (June) to 3.1 µg/L (August) (Appendix B5).
- Total iron concentrations exceeded the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) on all sampling dates, except June. Concentrations of total iron ranged from 427 µg/L (July) to 675 µg/L (September) (Appendix B5).
- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in August (1.7 µg/L) and September (1.1 µg/L). The dissolved selenium concentration in August was also higher than the CWQG (1.7 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Baseline radium-226 and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

#### 3.4.3.2 Ogama Outflow

Ogama Outflow is a clear, coloured freshwater stream, characterized by naturally soft water and low to moderate conductivity during open water conditions. No sampling was conducted during under-ice conditions.

The pH was near neutral to alkaline (6.8 to 8.3) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions and TDS were

similar to other streams in the Doris and Madrid Project Areas, with chloride as the dominant ion, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from 4 to 6 mg/L, with the highest concentration measured in September. Water colour was higher than the CDWG of < 15 TCU (Health Canada 2008) in June (57 TCU), July (25 TCU), and September (38 TCU).

Typical seasonal trends in water temperature were observed (i.e., water temperature in August was warmer than in July and September) (Figure 3.31). The warmest period occurred between late July and early August, with the warmest temperature recorded on 1 August 2008 (16.7°C) (Figure 3.31). The coolest temperature (1.8°C) was recorded on 24 June 2008. Ogama Outflow was the warmest stream in the Madrid Project Area, although similar maximum temperatures were measured in Patch and P.O. outflows. Ogama Outflow was well oxygenated throughout both sampling seasons (Appendix B3), with DO concentrations above the 9.5 mg/L CWQG for protection of early stages of cold water aquatic life (CCME 2007a).

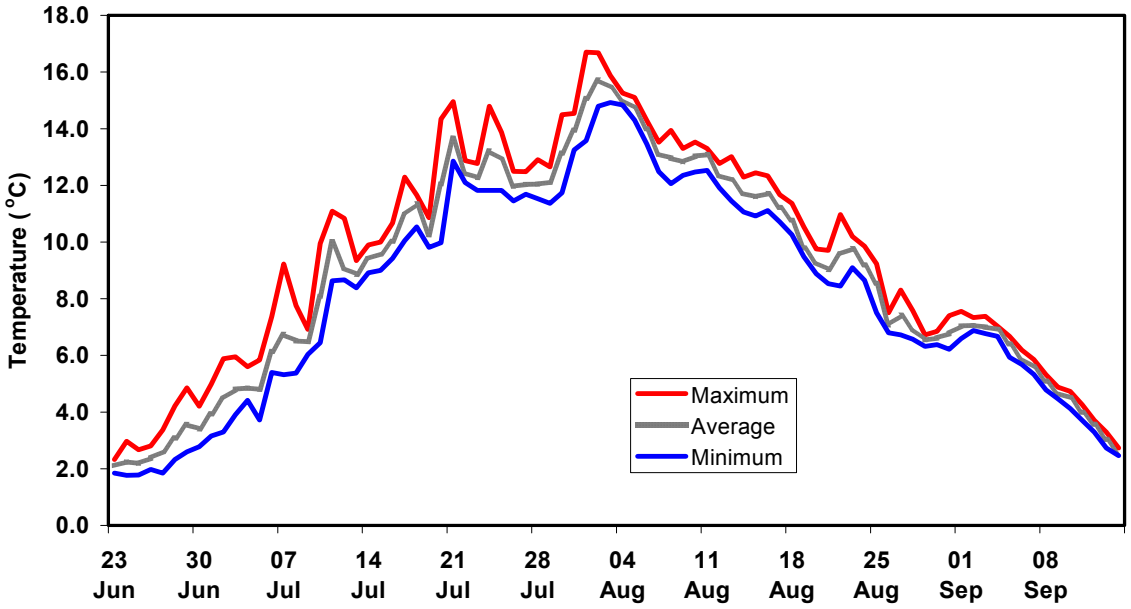


**Figure 3.31 Daily Maximum, Minimum, and Mean Water Temperatures in Ogama Outflow, June to September, 2008**

Total phosphorus in Ogama Outflow ranged between 23 and 32 µg/L (Appendix B5), which was consistent with phosphorus levels in Ogama

Lake. Based on this range of natural concentrations, Ogama Outflow is classified as meso-eutrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were similar to levels measured in Ogama Lake (TKN ranged from 0.39 to 0.55 mg/L) (Appendix B5). All of the dissolved inorganic forms of nitrogen were well below the applicable CWQGs, and represented < 4% of the total nitrogen concentration.

With the exception of total aluminum, iron, and selenium, total metal concentrations were below applicable CWQGs (Appendix B5). Baseline total iron and total manganese exceeded the CDWG aesthetic objectives. Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations in Ogama Outflow were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a) on all four sampling occasions, with concentrations ranging from 203 µg/L (August) to 385 µg/L (June) (Appendix B5).
- Total iron concentrations were above the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) on three of the four sampling occasions, with concentrations ranging from 333 µg/L (September) to 641 µg/L (June) (Appendix B5); the dissolved iron concentration in June (316 µg/L) was also higher than the CWQG and CDWG (Appendix B5).
- Total manganese was higher than the 50 µg/L CDWG aesthetic objective (Health Canada 2008) in July (62.5 µg/L).
- Total selenium concentrations were slightly higher than the sublethal toxicity 1 µg/L CWQG (CCME 2007a) in August, (1.1 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Baseline radium-226 and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

#### 3.4.3.3 Patch Outflow

Patch Outflow is a clear, freshwater stream, characterized by naturally soft water with low to moderate conductivity during open water conditions. No sampling was conducted during under-ice conditions.

The pH was neutral to alkaline (7.0 to 8.2) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWG for human consumption (Health Canada 2008). Concentrations of major ions and TDS were similar to Patch Lake, and to other streams in the Doris and Madrid Project Areas. The dominant ions were sodium, chloride, and bicarbonate (Appendix B5).

Total suspended solids ranged from < 1 to 2 mg/L, which indicated a high transparency. Similar suspended solids concentrations were measured in Patch Lake. Water colour was higher than the CDWG of < 15 TCU (Health Canada 2008) in June (29 TCU) and September (17 TCU).

Logged water temperature data in Patch Outflow showed that the warmest surface water temperatures occurred in early August (Figure 3.32). The maximum temperature (16.6°C) was measured on 1 August 2008, while the minimum temperature (1.4°C) was measured on the 21 and 22 of June 2008. Patch Outflow was among the warmest outflows in the Madrid Project Area. The outflow was well oxygenated, with DO concentrations consistently above the 9.5 mg/L CWQG for protection of early stages of cold water aquatic life (CCME 2007a) (Appendix B3).

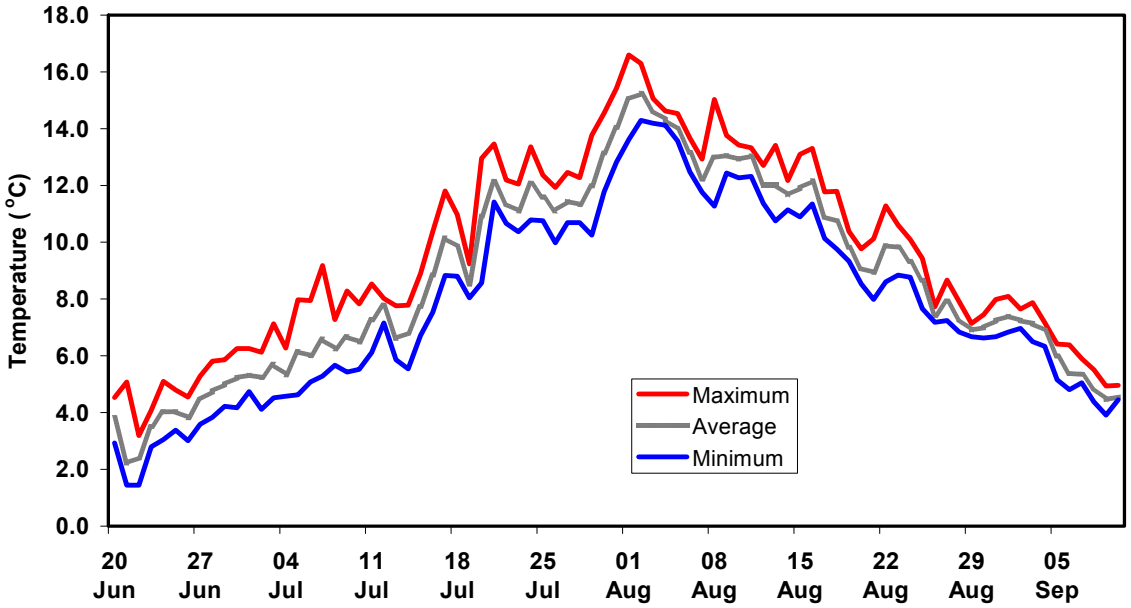


**Figure 3.32 Daily Maximum, Minimum, and Mean Water Temperatures in Patch Outflow, June to September, 2008**

In Patch Outflow, baseline total phosphorus concentrations ranged from 8 to 13 µg/L (Appendix B5), which was similar to those measured in Patch Lake. Based on this range of relatively low concentrations, Patch Outflow is classified as naturally oligo-mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were similar to levels measured in Patch Lake (TKN ranged from 0.20 to 0.27 mg/L) (Appendix B5). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs (CCME 2007a), and represented < 11% of the total nitrogen concentration.

With the exception of total aluminum and selenium, total metal concentrations were below applicable CWQGs and CDWGs (Appendix B5). Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) on three sampling occasions, ranging from 144 µg/L (August) to 199 µg/L (July).
- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in August (1.6 µg/L) and September (1.1 µg/L); the dissolved selenium concentration was also higher than the CWQG in August (1.4 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Radium-226 and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

### 3.4.3.4 Pelvic Outflow

Pelvic Outflow is a freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. Conductivity values measured in Patch Outflow were the lowest of the streams in the Madrid Project Area. No sampling was conducted during under-ice conditions.

The pH was neutral to alkaline (7.0 to 8.7) and within the CWQG for the protection of freshwater aquatic life (CCME 2007a). In August, the pH was above the CDWG upper limit of pH 8.5 for human consumption (Health Canada 2008) with a value of pH 8.7 (Appendices B5 and B7). Concentrations of TDS and major ions were similar to Pelvic Lake and within the concentration range

measured in the Doris and Madrid Project Areas. Chloride was the dominant ion, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from 2 to 16 mg/L, which represented the highest concentrations measured in streams in the Madrid Project Area. These levels were consistent with total suspended solids measured in Pelvic Lake. The highest concentrations occurred in August and September, which may be due, in part, to rain events that occurred one or two days prior to sampling. Water colour was higher than the CDWG of < 15 TCU (Health Canada 2008) in June (57 TCU) and September (22 TCU).

Logged temperature data in Pelvic Outflow showed the warmest surface waters in early August (Figure 3.33). The warmest temperature (15.7°C) was recorded on 2 August 2008 and the coolest temperature (2.1°C) was recorded on 27 June 2008. Pelvic Outflow was well oxygenated throughout the season, with DO concentrations above the 9.5 mg/L CWQG (CCME 2007a) (Appendix B3).

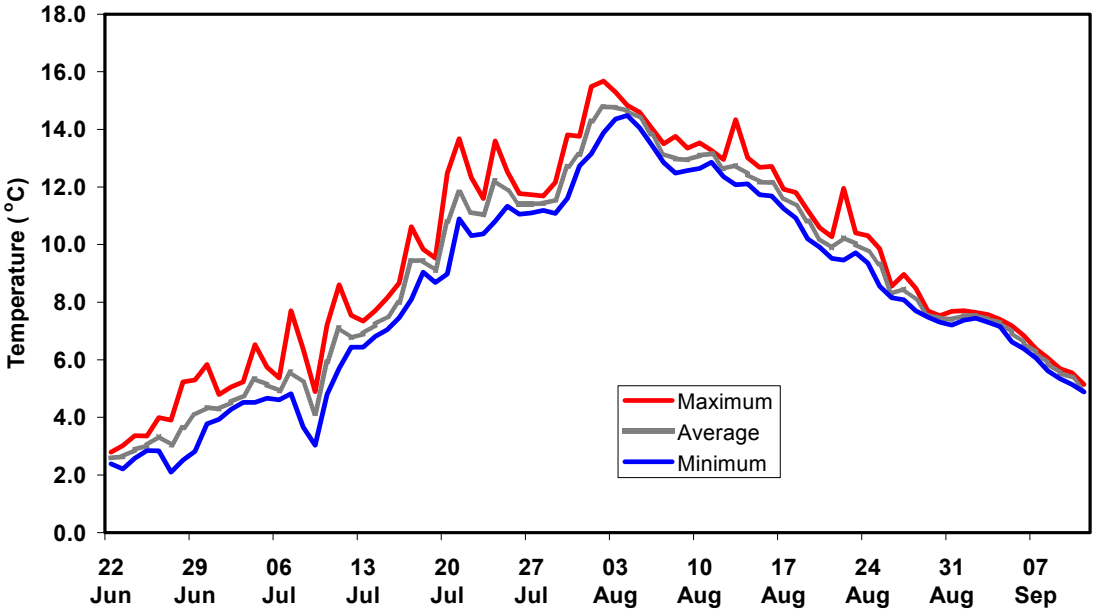


**Figure 3.33 Daily Maximum, Minimum, and Mean Water Temperatures in Pelvic Outflow, June to September, 2008**

Baseline total phosphorus concentrations in Pelvic Outflow ranged between 34 µg/L (June) and 67 µg/L (September) (Appendix B5). These levels were comparable to those measured in Pelvic Lake, and the highest measured in the streams in the Madrid Project Area. Based on the range of these concentrations,

Pelvic Outflow is classified as eutrophic (Appendix B1) (CCME 2004). The eutrophic condition of Pelvic Outflow was supported by visual observations of large patches of unidentified filamentous algae in the stream course. Total nitrogen concentrations were similar to levels measured in Pelvic Lake, and were also high in comparison with other streams in the Madrid Project Area (TKN ranged from 0.50 to 0.99 mg/L) (Appendix B5). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 4% of the total nitrogen concentration.

With the exception of total aluminum, iron, and selenium, total metal concentrations were below applicable CWQGs (Appendix B5). In addition, baseline total iron and manganese were above the CDWG aesthetic objectives. Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations in Pelvic Outflow were higher than the 100 µg/L CWQG for pH conditions (CCME 2007a) on all four occasions (Appendix B5), ranging from ranged from 195 µg/L (June) to 394 µg/L (September).
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) on three of the four sampling events, with concentrations ranging from 321 µg/L (June) to 504 µg/L (July).
- Total selenium was slightly higher than the 1 µg/L CWQG in August (1.1 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Baseline radium-226 and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

### 3.4.3.5 P.O. Outflow

P.O. Outflow is a clear, freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. No sampling was conducted during under-ice conditions.

The pH was slightly alkaline to alkaline (7.4 to 8.1) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of major ions and

TDS were similar to P.O. Lake and were consistent with the concentration range measured in the Doris and Madrid Project Areas. The dominant ion was chloride, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from < 1 to 5 mg/L, with the highest concentrations (5 mg/L) measured in August and September. Water colour was higher than the CDWG of < 15 TCU (Health Canada 2008) in June (46 TCU) and September (17 TCU).

Logged temperature data showed that the surface water temperatures in P.O. Outflow was warmest from mid-July to early August, which is the typical seasonal pattern observed in streams within the Madrid Project Area (Figure 3.34). The maximum temperature (16.6°C) was recorded on 2 August 2008, and the minimum temperature (1.2°C) was recorded on 23 June 2008. P.O. Outflow was well oxygenated during the 2008 sampling season, with DO concentrations above the 9.5 mg/L CWQG for protection of early life stages of cold water aquatic biota (Appendix B3).

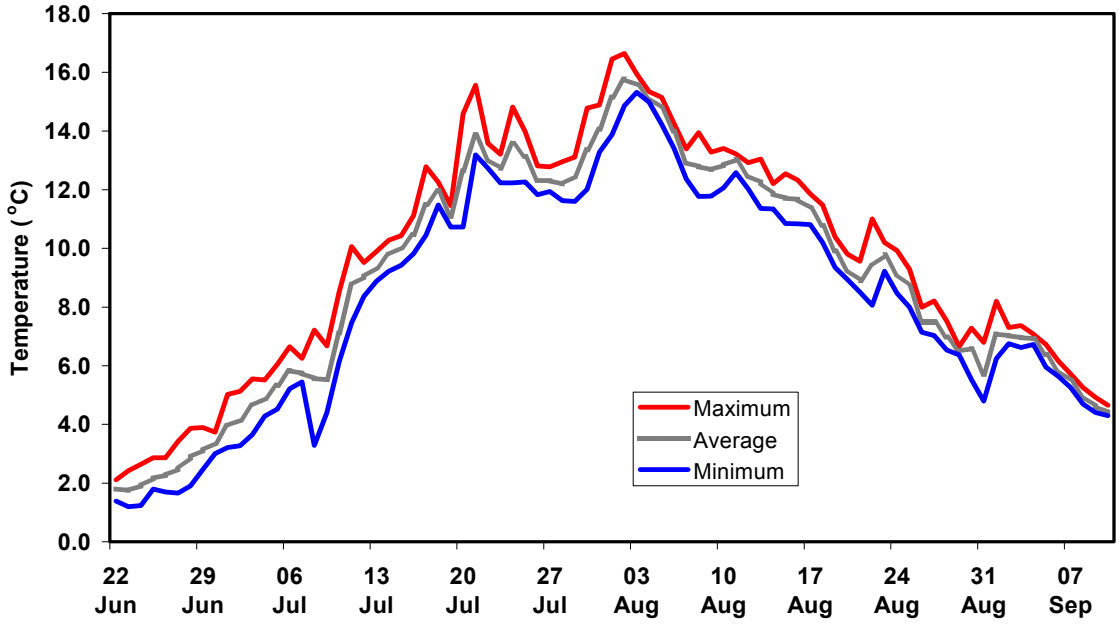


**Figure 3.34 Daily Maximum, Minimum, and Mean Water Temperatures in P.O. Outflow, June to September, 2008**

Baseline total phosphorus concentrations in P.O. Outflow ranged from 14 to 18 µg/L (Appendix B5), which was similar to P.O. Lake (Appendix B5). Based

on these baseline concentrations, P.O. Outflow is classified as mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were generally similar to levels measured in P.O. Lake (TKN ranged from 0.23 to 0.34 mg/L) (Appendix B5). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 5% of the total nitrogen concentration.

With the exception of total aluminum, chromium, iron, and selenium, all remaining total metals were below applicable CWQGs (CCME 2007a). Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH conditions > 6.5 (CCME 2007a) on all four sampling occasions, with concentrations ranging from 226 µg/L (June) to 718 µg/L (September).
- Total chromium concentrations were slightly higher than the sublethal 1 µg/L CWQG for Cr(VI) (CCME 2007a) in July and September (1.1 µg/L) (Appendix B5). These exceedences are likely to be very conservative because the guideline refers to Cr(VI) not total chromium (CCME 2007a). Naturally occurring dissolved chromium concentrations accounted for only 21% and 41%, respectively, of the total chromium concentrations.
- Total iron concentrations were higher than the 300 µg/L CWQG (CCME 2007a) and CDWG aesthetic objective (Health Canada 2008) in July (483 µg/L) and September (440 µg/L).
- Total selenium concentrations were higher than the 1 µg/L CWQG in August (1.4 µg/L) and September (1.3 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Baseline radium-226 and total cyanide concentrations were below their applicable MRVs (0.005 Bq/L and 0.001 mg/L, respectively) throughout open water conditions (Appendix B5).

### 3.4.3.6 Windy Outflow

Windy Outflow is a clear, freshwater stream characterized by naturally soft water and low to moderate conductivity during open water conditions. No sampling was conducted under-ice conditions.

The pH was slightly alkaline to alkaline (7.5 to 8.0) and within the CWQGs for the protection of freshwater aquatic life (CCME 2007a) and the CDWGs for human consumption (Health Canada 2008). Concentrations of TDS and major ions were similar to those measured in Windy Lake, and were consistent with the concentration range measured in the Doris and Madrid Project Area. The dominant ion was chloride, followed by sodium and bicarbonate (Appendix B5).

Total suspended solids ranged from < 1 to 1 mg/L, which indicated high water transparency. This water clarity was observed in Windy Lake. Water colour was slightly higher than the CDWG of < 15 TCU (Health Canada 2008) in June (18 TCU).

Logged temperature data for surface waters in Windy Outflow showed that August was the warmest month (Figure 3.35). The maximum temperature (15.6°C) was recorded on 1 August 2008, and the minimum temperature (2.0°C) was recorded on 27 June 2008. The outflow was well oxygenated throughout the summer months, with DO concentrations above the 9.5 mg/L CWQG (CCME 2007a) (Appendix B3).

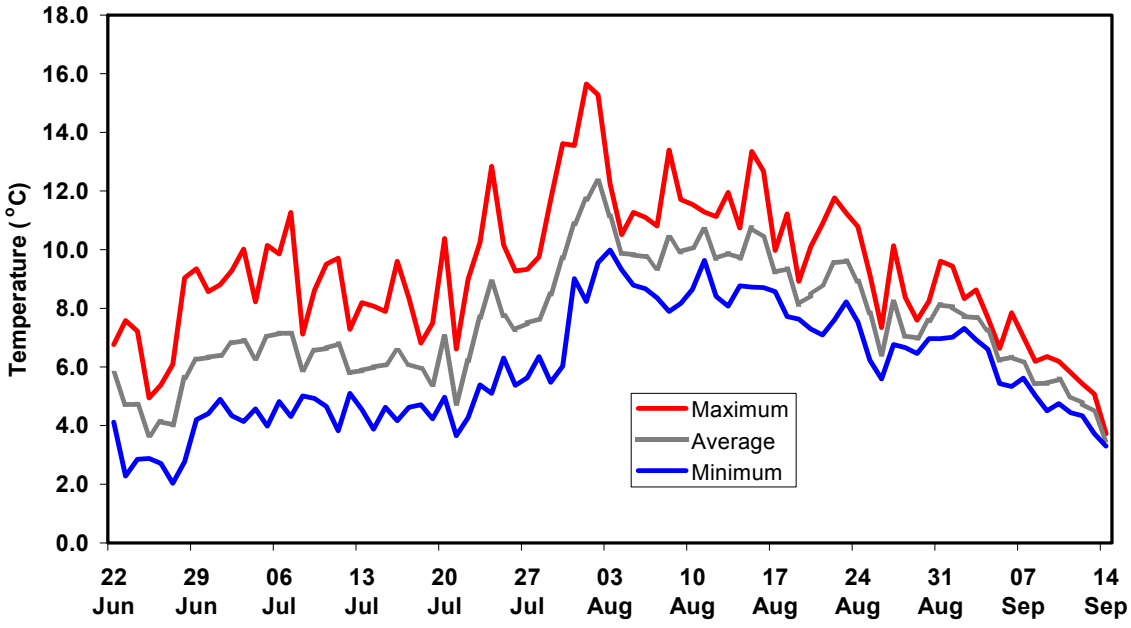


**Figure 3.35 Daily Maximum, Minimum, and Mean Water Temperatures in Windy Outflow, June to September, 2008**

Baseline total phosphorus concentrations in Windy Outflow ranged from 7 to 11 µg/L, which were consistent with the concentrations measured in Windy Lake (Appendix B5). Based on these low baseline phosphorus levels, Windy Outflow is classified as oligo-mesotrophic (Appendix B1) (CCME 2004). Total nitrogen concentrations were also consistent with levels measured in Windy Lake (TKN ranged from 0.12 to 0.17 mg/L) (Appendix B5). Concentrations of dissolved inorganic forms of nitrogen (i.e., ammonia, nitrate, and nitrite) were well below applicable CWQGs, and represented < 10% of the total nitrogen concentration. The nitrogen and phosphorus concentrations were the lowest nutrient concentrations in streams of the Madrid Project Area.

With the exception of total aluminum, cadmium, and selenium, total metal concentrations were below applicable CWQGs (Appendix C5). No CDWGs were exceeded in Windy Lake (Health Canada 2008). Baseline total metals that were above guidelines are listed below:

- Total aluminum concentrations were higher than the 100 µg/L CWQG for pH values > 6.5 (CCME 2007a) in June (159 µg/L) and July (112 µg/L) (Appendix B5).
- Total cadmium was higher than the site adjusted 0.025 µg/L CWQG of (calculated based on a sample hardness of 73 mg $CaCO_3$/L) in September (0.036 µg/L) (Appendix B5).
- Total selenium concentrations were higher than the 1 µg/L CWQG (CCME 2007a) in August (2.2 µg/L) and September (1.3 µg/L). Dissolved selenium concentrations were also higher than the CWQG in August (1.8 µg/L) and September (1.2 µg/L) (Appendix B5).

For most metals, the proportion of the dissolved fraction was moderate to high, accounting for 50 to 100% of the total concentration (Appendix B5).

Baseline radium-226 concentrations were below the MRV (0.005 Bq/L) on all sampling occasions, with the exception of August (0.008 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) throughout the open water season (Appendix B5).

### 3.4.3.7 Madrid Project Area Streams Summary

The water quality of streams within the Madrid Project Area was consistent with the associated lakes in the Project Area. The streams were coloured, and characterized as soft with naturally low to moderate conductivity. In many cases, the water colour was more pronounced in June and September, often above

CDWGs. The range of pH values was near neutral to alkaline and the major ions were generally dominated by sodium, chloride, and bicarbonate.

Logged temperatures in the surface waters of the streams and rivers indicated that the warmest temperatures occurred during late July and early August. Glenn Outflow was the coolest stream in the Madrid Project Area and Ogama Outflow the warmest. The streams were well oxygenated over the open water season, with measured DO concentrations consistently above the 9.5 mg/L CWQG.

Baseline phosphorus concentrations in the streams and rivers in the Madrid Project Area were highly variable, but consistent with levels measured in their associated lakes. Based on the total phosphorus concentrations, the streams in the Madrid Project Area were classified as oligo-mesotrophic (e.g., Patch Outflow, Windy Outflow), mesotrophic (Glenn Outflow, P.O. Outflow), meso-eutrophic (Ogama Outflow), and eutrophic (Patch Outflow). The nitrogen to phosphorus ratio for streams in the Madrid Project Area indicated phosphorus limitation.

Baseline concentrations of total aluminum, cadmium, chromium, copper, iron, manganese, and selenium were measured above applicable CWQGs and CDWGs guidelines on at least one sampling occasion (Table 3.22). As no significant intensive developments are located in the Doris Project Area watersheds, the total metals concentrations were from natural catchment sources.

Baseline radium-226 concentrations were below the MRV (0.005 Bq/L) in all streams throughout open water conditions, with the exception being Windy Outflow (August: 0.008 Bq/L). Total cyanide concentrations were consistently below the MRV (0.001 mg/L) in all streams.

A summary of select baseline water quality parameters in Madrid Project Area streams are presented in Table 3.23, which includes summary data from 2006 and 2007. These parameters include the parameters required under the MMER (Environment Canada 2002) and parameters that typically exceed CWQGs in the streams. Overall, median results from 2008 were generally consistent with the range of data collected in previous years.

**Table 3.22 Guideline Exceedences in the Madrid Project Area Streams, 2008**

| Site | Date 2008 | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) (µg/L) | Cadmium (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) | Manganese (Total) (µg/L) | Selenium (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CWQG 6.5-9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 0.025 µg/L[b] | CWQG 2 µg/L | CWQG 1.0 µg/L[c] | CWQG 300 µg/L | CDWG <50 ug/L[a] | CWQG 1 µg/L |
| | | CDWG 6.5-8.5[a] | | | CDWG 5 µg/L | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] | | CDWG 10 µg/L |
| Glenn Outflow | 19-Jun | 6.8 | 1 | **267** | | **2.4** | | | | |
| | 17-Jul | 7.8 | 8 | **700** | | **2.9** | **1.16** | **535** | | |
| | 19-Aug | 8.1 | 2 | **605** | | **3.1** | | **427** | | **1.7** |
| | 13-Sep | 8.3 | 7 | **858** | | **3.5** | **1.5** | **675** | | **1.1** |
| Ogama Outflow | 23-Jun | 6.8 | 4 | **385** | | | | **641** | | |
| | 17-Jul | 7.5 | 3 | **240** | | | | **437** | **62.5** | |
| | 19-Aug | 8 | 4 | **203** | | | | | | **1.1** |
| | 14-Sep | 8.3 | 6 | **338** | | | | **333** | | |
| Patch Outflow | 17-Jul | 7.6 | <1 | **199** | | | | | | |
| | 19-Aug | 8.2 | <1 | **144** | | | | | | **1.6** |
| | 10-Sep | 8 | 2 | **159** | | | | | | **1.1** |
| Pelvic Outflow | 21-Jun | 7.1 | 2 | **195** | | | | **321** | | |
| | 17-Jul | 7.4 | 6 | **186** | | | | **504** | | |
| | 19-Aug | **8.7** | 10 | **236** | | | | | | **1.1** |
| | 11-Sep | 7.8 | 16 | **394** | | | | **362** | **54.9** | |
| P.O. Outflow | 21-Jun | 7.4 | 2 | **226** | | | | | | |
| | 17-Jul | 7.6 | 5 | **564** | | | **1.09** | **483** | | |
| | 19-Aug | 8.1 | <1 | **299** | | | | | | **1.4** |

Prepared by: JM Checked by: CC

## Table 3.22 Guideline Exceedences in the Madrid Project Area Streams, 2008 (Cont.)

| Site | Date 2008 | Field pH | Total Suspended Solids (mg/L) | Aluminum (Total) (µg/L) | Cadmium (Total) (µg/L) | Copper (Total) (µg/L) | Chromium (Total) (µg/L) | Iron (Total) (µg/L) | Manganese (Total) (µg/L) | Selenium (Total) (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | CWQG 6.5-9.0 | | CWQG 100 µg/L when pH ≥ 6.5 | CWQG 0.025 µg/L[b] | CWQG 2 µg/L | CWQG 1.0 µg/L[c] | CWQG 300 µg/L | CDWG <50 ug/L[a] | CWQG 1 µg/L |
| | | CDWG 6.5-8.5[a] | | | CDWG 5 µg/L | CDWG <1000 µg/L[a] | CDWG 50 µg/L | CDWG <300 µg/L[a] | | CDWG 10 µg/L |
| | 10-Sep | 7.9 | 5 | **718** | | | **1.13** | **440** | | **1.3** |
| Windy Outflow | 22-Jun | 7.5 | 1 | **159** | | | | | | |
| | 17-Jul | 7.5 | <1 | **112** | | | | | | |
| | 19-Aug | 8 | <1 | | | | | | | **2.2** |
| | 14-Sep | 8 | <1 | | **0.036** | | | | | **1.3** |

CWQG = Canadian Water Quality Guideline; CDWG = Canadian Drinking Water Guideline

[a] Aesthetic objective.

[b] Cd CWQG was adjusted for hardness for both sites; all other sites had Cd concentrations below site-adjusted CCME guidelines; see sub-section 3.2.4.1 in report text for details.

[c] For Cr sublethal toxicity the CCME guideline is 1.0 µg/L, for acute toxicity the USEPA guideline is 16 µg/L; see Sub-section 3.2.4.1 in report text for details.

TSS and pH are presented to help in interpretation of the values greater than the guidelines. **Bolded values** exceed the CWQG; **bolded and grey shaded values** exceed the CDWG and CWQG; **bolded and blue shaded values** exceed the CDWG.

**Table 3.23 Summary of Select Baseline Water Quality Parameters in the Madrid Project Area Streams, 2006-2008**

| Parameter | Units | 2008 | | | | | 2006-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | N/A | 24 | 7.8 | 0.5 | 6.8 | 8.7 | 40 | 7.3 | 0.5 | 6.5 | 8.8 |
| TSS | mg/L | 24 | 2 | 3.8 | <1 | 16 | 45 | 3 | 2.9 | <1 | 10 |
| DO | mg/L | 20 | 12.7 | 0.76 | 11.3 | 14.0 | 43 | 11.3 | 2.0 | 7.9 | 16.5 |
| Conductivity | µS/cm | 24 | 264 | 84 | 105 | 434 | 45 | 302 | 88 | 55 | 437 |
| Total Phosphorous | µg/L | 24 | 17 | 16 | 7 | 67 | 45 | 19 | 18 | 3 | 73 |
| Aluminum | µg/L | 24 | 231 | 223 | 46.6 | 858 | 45 | 143 | 178 | 26.5 | 763 |
| Cadmium | µg/L | 24 | 0.0026 | 0.0070 | <0.002 | 0.0357 | 45 | 0.0027 | 0.0023 | <0.002 | 0.0103 |
| Copper | µg/L | 24 | 1.3 | 0.73 | 0.83 | 3.5 | 45 | 1.4 | 0.70 | 0.57 | 4.1 |
| Mercury | ng/L | 24 | <0.6 | 1.2 | <0.6 | 4 | 45 | <0.6 | 1.1 | <0.6 | 5 |
| Selenium | µg/L | 24 | 0.8 | 0.5 | 0.2 | 2.2 | 45 | 1.1 | 0.4 | 0.4 | 2.0 |
| Zinc | µg/L | 24 | 1.6 | 0.8 | 0.2 | 3.9 | 45 | 2.1 | 1.9 | 0.2 | 11 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen; N/A=not applicable

Prepared by: DG Checked by: CC

## 3.4.4 Summary of Water Quality in Freshwater Streams

All freshwater streams and rivers within the Project Area were characterized by naturally soft waters. The pH was typically near neutral to slightly alkaline, although slightly acidic pH values were documented under ice-covered conditions. The pH values in Roberts (July) and Pelvic (August) outflows were slightly higher than the CDWG range of pH 6.5 to 8.5; however, the pH was still within the CWQG range of pH 6.5 to 9.0 for protection of freshwater aquatic life. In June, the pH in Fickle Duck Outflow fell below the minimum pH 6.5 of the CWQG and CDWG. Sodium, chloride, and bicarbonate typically dominated the ions in most of the streams, with the addition of calcium in most of the streams in the Boston Project Area. Streams within the Boston Project Area had the lowest concentrations of major ions, whereas streams within the Doris Project Area had the highest concentrations. This was similar to major ion concentrations in lakes within these areas.

TSS was typically low in all of the Project streams. The spring freshet (June) samples typically had higher TSS levels with a maximum of 23 mg/L recorded in Koignuk River. Most of the Madrid Project Area streams, with the exception of Glenn and Windy outflows, had maximum TSS concentrations reported in September. Late August and early September were wet months with more surface runoff than in July, which may explain the elevated TSS levels. The Project Area lakes are all generally coloured with true colour measurements between < 1 TCU and 60 TCU (Aimaokatalok Inflow [August]).

Water temperature exhibited typical seasonal patterns, with warmest temperatures observed in late July to early August. Streams and rivers were well oxygenated, and the few occurrences of lower DO concentrations were still above the CWQG of 6.5 for the protection of all but the early life stages of cold freshwater aquatic biota (CCME 2007a).

Baseline total phosphorus concentrations in streams and rivers were comparable to their associated lakes. The trophic classification of the streams in the Project Area ranged from naturally oligotrophic to eutrophic. Pelvic Outflow was the only eutrophic stream and Aimaokatalok Inflow was the only oligotrophic stream based on total phosphorus concentrations (CCME 2004). The nitrogen to phosphorus ratio for streams in all of the Project streams indicated phosphorus limitation.

Concentrations of most total metals were below the applicable CWQGs (CCME 2007a) and CDWGs (Health Canada 2008). Baseline total metal concentrations that were above applicable CWQGs and CDWGs were limited to aluminum, cadmium, chromium, copper, iron, manganese, and selenium, which are summarized in Tables 3.24 and 3.25.

Elevated concentrations occurred in all of the streams and rivers in the Boston Project Area in 2008, except Stickleback Outflow. The CWQG for total aluminum was exceeded in all streams and rivers except for Tail Outflow. Only Windy Outflow exceeded the site specific CWQG for total cadmium. Baseline total iron was above the CWQG and CDWG in most streams and rivers, with the exception of Aimaokatalok, Patch, and Windy outflows. Baseline total selenium was higher than the CWQG in all of the Madrid Project Area streams, Roberts Outflow and Tail Outflow; Boston Project Area streams did not exceed the CWQG. Baseline total iron and total manganese were higher than the CDWG aesthetic objectives in several waterbodies throughout the sampling period. Similar guideline exceedences were documented in previous studies conducted between 2003 and 2007 (Appendix B6). Elevated total concentrations of aluminum, chromium, iron, and selenium especially in June are likely to be related, in part, to elevated TSS associated with runoff from ice melt and rain events transporting sediment into the streams and rivers.

In general, baseline radium-226 concentrations were below the MRV of 0.005 Bq/L in lakes and streams within the Boston and Madrid Project Areas (radium-226 was not measured in water samples from the Doris Project Area). Radium-226 concentrations were measured in five streams including Aimaokatalok Inflow, Aimaokatalok Outflow, Fickle Duck Outflow, Reference

Outflow, and Windy Outflow. Total cyanide concentrations were consistently below the MRV of 0.001 mg/L in all streams and rivers.

**Table 3.24 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Boston and Doris Project Areas, 2008**

| Waterbody | Parameter | Date Exceedance Occurred (2008) |
|---|---|---|
| **Boston Project Area** | | |
| Aimaokatalok Inflow | total aluminum | 24-Jun, 19-Jul, 13-Aug, 8-Sep |
| | total cadmium | 19-Jul |
| | total chromium | 24-Jun |
| | total iron | 24-Jun[a], 19-Jul[a], 13-Aug[a], 8-Sep[a] |
| Aimaokatalok Outflow | total aluminum | 24-Jun |
| Aimaokatalok River | total aluminum | 24-Jun |
| | total copper | 15-Sep |
| | total iron | 15-Aug[a] |
| Fickle Duck Outflow | pH | 26-Jun[a] |
| | total aluminum | 26-Jun, 14-Aug, 15-Sep |
| | total copper | 15-Sep |
| | total iron | 26-Jun[a], 18-Jul[a], 14-Aug[a], 15-Sep[a] |
| Koignuk River | total aluminum | 23-Jun, 17-Jul, 19-Aug, 14-Sep |
| | total cadmium | 14-Sep |
| | total chromium | 23-Jun, 14-Sep |
| | total iron | 23-Jun[a], 14-Sep[a] |
| Reference Outflow | total aluminum | 24-Jun |
| | total iron | 24-Jun[a], 18-Jul[a] |
| **Doris Project Area** | | |
| Doris Outflow | total aluminum | 22-Jun |
| | total copper | 22-Jun |
| | total iron | 22-Jun[a] |
| | total selenium | 14-Aug |
| Little Roberts Outflow | total aluminum | 19-Jun, 17-Jul |
| | total iron | 19-Jun[a] |
| | total selenium | 14-Aug, 12-Sep |
| Roberts Outflow | pH | 17-Jul[b] |
| | total aluminum | 19-Jun, 17-Jul, 12-Sep |
| | total chromium | 19-Jun |
| | total iron | 19-Jun[a] |
| Tail Outflow | total iron | 14-Aug[a] |

Note: Jul = July; Aug = August; Sep = September.
[a] CWQG and CDWG exceeded
[b] CDWG exceeded

Prepared by: SJ Checked by: AH

**Table 3.25 Baseline Parameters above CWQGs and CDWGs in Waterbodies within the Madrid Project Areas, 2008**

| Waterbody | Parameter | Date Exceedence Occurred (2008) |
|---|---|---|
| **Madrid Project Area** | | |
| Glenn Outflow | total aluminum | 19-Jun, 17-Jul, 19-Aug, 13-Sep |
| | total copper | 19-Jun, 17-Jul, 19-Aug, 13-Sep |
| | total chromium | 17-Jul, 13-Sep |
| | total iron | 17-Jul[a], 19-Aug[a], 13-Sep[a] |
| | total selenium | 19-Aug, 13-Sep |
| Ogama Outflow | total aluminum | 23-Jun, 17-Jul, 19-Aug, 14-Sep |
| | total iron | 23-Jun[a], 17-Jul[a], 14-Sep[a] |
| | total manganese | 17-Jul[b] |
| | total selenium | 19-Aug |
| Patch Outflow | total aluminum | 17-Jul, 19-Aug, 10-Sep |
| | total selenium | 19-Aug, 10-Sep |
| Pelvic Outflow | pH | 19-Aug[b] |
| | total aluminum | 21-Jun, 17-Jul, 19-Aug, 11-Sep |
| | total iron | 21-Jun[a], 17-Jul[a], 11-Sep[a] |
| | total manganese | 11-Sep[b] |
| | total selenium | 19-Aug |
| P.O. Outflow | total aluminum | 21-Jun, 17-Jul, 19-Aug, 10-Sep |
| | total chromium | 17-Jul, 10-Sep |
| | total iron | 17-Jul[a], 10-Sep[a] |
| | total selenium | 19-Aug, 10-Sep |
| Windy Outflow | total aluminum | 22-Jun, 17-Jul |
| | total cadmium | 14-Sep |
| | total selenium | 19-Aug, 14-Sep |

Notes: Jul = July; Aug = August; Sep = September.
[a] CWQG and CDWG exceeded
[b] CDWG exceeded

Prepared by: SJ Checked by: AH

## 3.5 RESULTS AND DISCUSSION: MARINE BAYS

The following section provides a summary of the water quality results in marine bays within the Madrid and Doris Project Areas. Detailed discussions for each marine bay are provided under respective bay headings. All field measurements, including water profiles of temperature and DO, as well as pH, conductivity, and Secchi depth are provided in Appendices B3 and B4. Chl *a* concentrations are provided in Appendix B7. Water chemistry data, including QA/QC data, are

presented in Appendices B2 and B7. CDWGs were not applied to marine sites, though historical CWQG exceedences are presented in Appendix B8.

## 3.5.1 Boston Project Area Marine Site

### 3.5.1.1 Hope Bay

The sampling station in Hope Bay is moderately deep (approximately 15 m). The pH values (7.6 to 8.1) were consistent with the range expected for marine waters, and are within the CWQG of pH 7.0 to 8.7 for the protection of marine life (CCME 2007a). TDS concentrations in July were lower in the top sample (2,200 mg/L) and higher in the bottom sample (27,000 mg/L) compared to August and September when TDS was between 15,000 mg/L (top) and 19,000 mg/L (bottom) (Appendix B7). The lower surface TDS in July is indicative of the extent of freshwater input to the bay during spring melt conditions. Higher TDS concentrations in bottom samples are associated with the density difference between the freshwater input and marine waters. Low density freshwater, particularly in high flow periods, will enter the bay and flow over the surface of the more dense marine waters. The extent of any TDS gradient through the water column will be dependent on the volume of freshwater inflow and the stability of the bay environment (calm conditions will maintain a disctinct gradient between the surface and the bottom of the water column, whereas stormy conditions and high wave action will promote active mixing through a deeper proportion of the water column). As the bay is relatively deep, higher TDS waters will persist in the deeper portions of the water column.

The water column in Hope Bay was thermally stratified in both July and August. In July, the temperature decreased from approximately 10°C at the surface to 1.6°C at 5 m depth (Figure 3.36; Appendix B4). From 5 m depth to the bottom, the temperature decreased from 1.6°C to 0.2°C. In August, the thermocline within Hope Bay had dropped to a depth of 10 m. Temperature decreased from 7.3°C to 2°C between the thermocline and the bottom of the bay. Despite the presence of a thermocline, the water column remained well oxygenated (≥ 12 mg/L) (Figure 3.36 and Appendix B4), with DO concentrations consistently above the CWQG of > 8.0 mg/L for marine waters (CCME 2007a).

Total suspended solids concentration Hope Bay ranged from < 4 to 11 mg/L, with Secchi depths between 2.0 and 5.0 m. Although not generally supported by the total suspended solids concentrations, water transparency improved over the sampling period, which is likely a result of the reduction in the influence of elevated stream and river flow to the bay during spring freshet.

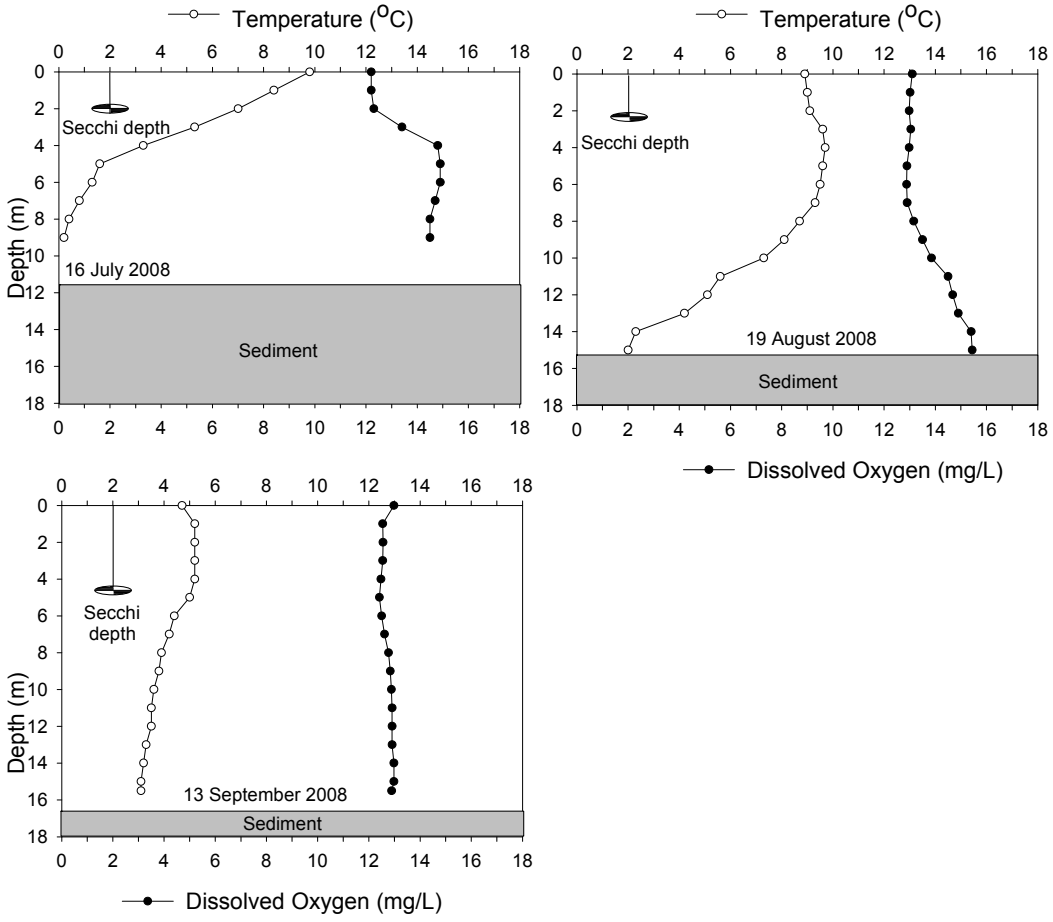


**Figure 3.36 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Hope Bay, 2008**

Baseline total phosphorus concentrations ranged from 6 to 61 µg/L; however, there was some variation in the MRV for total phosphorus through the sampling program, with a lower MRV used for the July samples. Total phosphorus concentrations ranged from 6 µg/L (top sample) and 29 µg/L (bottom sample) in July, and < 50 and 61 µg/L in August and September. Total Kjeldahl Nitrogen concentrations ranged between 100 and 140 µg/L, with dissolved inorganic nitrogen (nitrate, nitrite, ammonia) contributing up to 32% of the total nitrogen. Ammonia concentrations ranged from 8 µg N/L (July top) to 41 µg N/L (July bottom); higher ammonia concentrations were evident in the bottom samples. Chl *a* concentrations ranged from 0.30 to 0.44 µg/L (Appendix B7). Based on the Trophic Index (TRIX) for marine systems, Hope Bay would be conservatively classified as naturally mesotrophic (CCME 2007b).

The CCME is still in the process of developing CWQGs for many of the marine parameters for which environmental toxicity is well established in freshwater. The majority of baseline total metal concentrations for which CWQGs do exist for the marine environment were below the corresponding guidelines (Appendix B7). The only exception was total cadmium (Appendix B7), which was higher than the 0.12 µg/L guideline in July (bottom sample = 0.15 µg/L).

Baseline radium-226 concentrations were below the MRV of 0.005 Bq/L on all sampling occasions, with the exception of August (0.008 Bq/L) (Appendix B7).

## 3.5.2 Doris Project Area Marine Site

### 3.5.2.1 Roberts Bay

The sampling station in Roberts Bay is shallow (approximately 4 m deep). The pH was slightly alkaline (7.4 to 8.1) and within the CWQG of pH 7.0 to 8.7 (CCME 2007a). TDS concentrations were lower in July (top = 5400 mg/L; bottom = 6300 mg/L) compared to August and September when TDS was consistently 21,000 mg/L (Appendix B7). The lower TDS in July, especially in comparison to Hope Bay, is associated with the greater influence freshwater input from ice melt conditions will have on a shallower bay environment.

The water column in Roberts Bay did not thermally stratify during the open water season, and water temperatures remained cool during the open water season (Figure 3.37 and Appendix B4). The water column remained well oxygenated (≥ 13 mg/L) (Figure 3.37 and Appendix B4), with DO concentrations consistently above the CWQG of > 8.0 mg/L for marine waters (CCME 2007a).

Total suspended solids concentrations in Roberts Bay ranged from 4 to 27 mg/L, with the highest concentrations measured in the surface waters. Secchi depths ranged between 1.3 and 3.4 m, with the highest water transparency in September. As noted for Hope Bay, there was little discernible correlation between surface water total suspended solids concentrations and secchi depths.

Baseline total phosphorus concentrations were consistent through the water column in July (8 µg/L). The concentrations for August and September were all below the higher MRV < 50 µg/L). Total Kjeldahl Nitrogen concentrations ranged between 60 and 110 µg/L, with dissolved inorganic nitrogen (nitrate, nitrite, ammonia) contributing up to 33% of the total nitrogen. Ammonia concentrations ranged from 8 µg N/L (July top) to 20 µg N/L (all August and September samples). Chl *a* concentrations ranged from 0.36 to 0.47 µg/L (Appendix B7). Although total phosphorus data are limited because of the high

MRV, Roberts Bay could be conservatively classified as naturally mesotrophic based on the TRIX for marine systems (CCME 2007b).

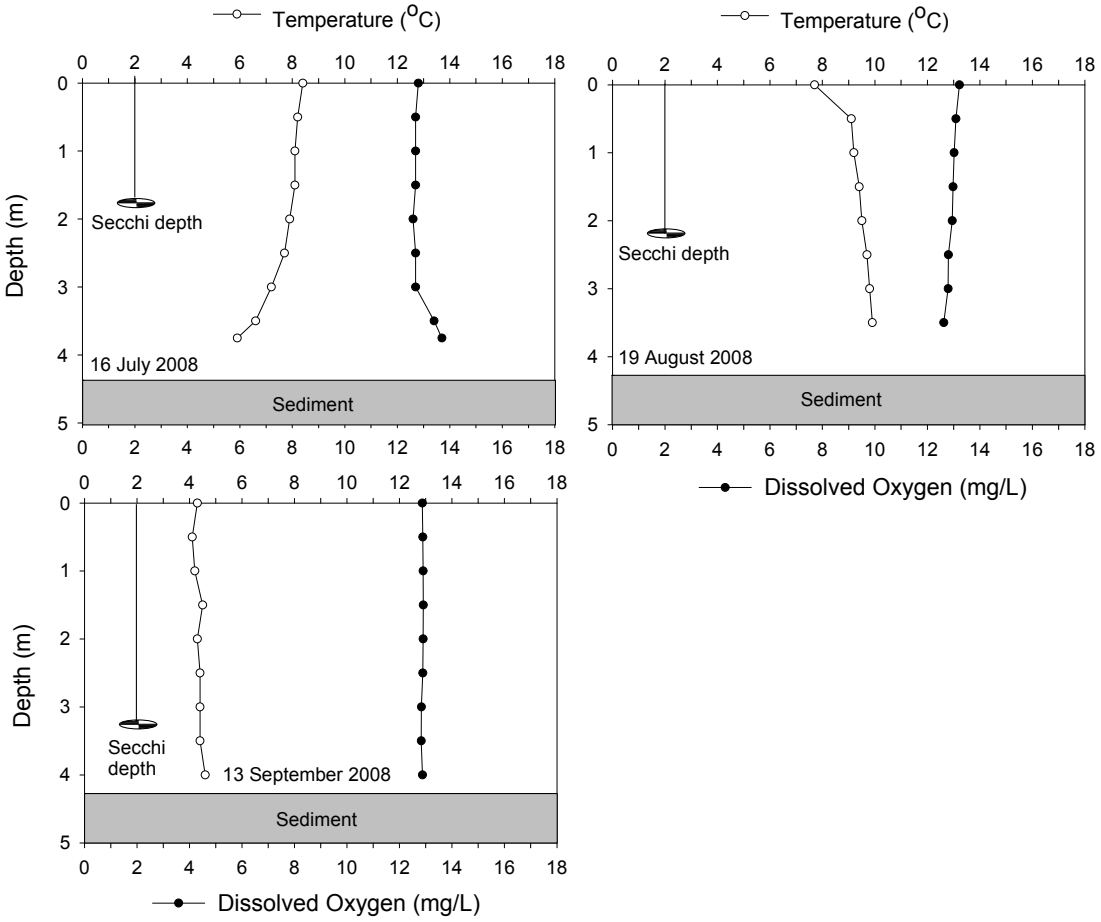


**Figure 3.37 Temperature and Dissolved Oxygen Profiles and Secchi Depths for Roberts Bay, 2008**

As previously discussed, there are few CWQGs for marine parameters for which environmental toxicity is well established in freshwater. All baseline total metal concentrations were below existing for CWQGs for marine waters (Appendix B7).

Baseline radmium-226 was not analyzed in the Roberts Bay water samples as data on this parameter were consistently below the MRV in 2005 (Golder 2006a)

### 3.5.2.2 Summary of Water Quality in Marine Bays

The two marine bays within the Project Area include both deep (Hope Bay) and shallow (Roberts Bay) waters, which exhibited differences in thermal stratification throughout the sampling program. Hope Bay was thermally stratified in July and August; however, the water column remained well oxygenated. Roberts Bay did not stratify, and DO concentrations remained high.

Total phosphorus, total nitrogen, Chl *a*, and Secchi depth were used to classify the trophic status of the bays. While there is some uncertainty in the total phosphorus data because of varying MRVs, both bays were conservatively classified as naturally mesotrophic.

A summary of select water quality parameters in the marine bays are presented in Table 3.26, which include comparison data collected from 2004 to 2007. These parameters include those that are required under the MMER (Environment Canada 2002) and those that typically above the CWQGs in the Project Areas. Overall, some variability between mean results for the select water quality parameters was evident between the 2008 data and that for 2004 and 2007. Metals concentrations were generally lower, with the exception of cadmium. Total cadmium was above the CWQG on one sampling date in Hope Bay in 2008 (Table 3.27).

**Table 3.26 Summary of Select Baseline Water Quality Parameters in Marine Waters within the Boston and Doris Project Areas, 2008**

| Parameter | Units | 2008 | | | | | 2004-2007 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | n | Median | SD | Min | Max | n | Median | SD | Min | Max |
| pH (Field) | N/A | 6 | 8.0 | 0.29 | 7.4 | 8.1 | 12 | 6.8 | 0.66 | 6.2 | 8.0 |
| TSS | mg/L | 12 | 11.0 | 7.69 | <4 | 27 | 29 | 4.2 | 3.99 | <1 | 17 |
| DO | mg/L | 6 | 12.9 | 0.36 | 12.2 | 13.2 | 17 | 11.7 | 1.59 | 9.6 | 15.5 |
| Conductivity | µS/cm | 12 | 30,000 | 11,400 | 4,000 | 41,000 | 28 | 28,950 | 11,200 | 5,910 | 41,000 |
| Total Phosphorus | µg/L | 12 | 25 | 14 | 6 | 61 | 29 | 24 | 8 | 9 | 41 |
| Aluminum | µg/L | 12 | 26 | 39.4 | 19.0 | 123 | 26 | 50 | 187 | 9.2 | 989 |
| Cadmium | µg/L | 12 | 0.0500 | 0.0344 | 0.0200 | 0.1500 | 30 | 0.0246 | 0.0320 | <0.002 | 0.1000 |
| Copper | µg/L | 12 | 0.85 | 0.13 | 0.70 | 1.10 | 30 | 1.3 | 2.22 | 0.42 | 10.30 |
| Mercury | ng/L | 12 | 0.8 | 0.4 | <0.6 | 2 | 28 | 1.5 | 3.6 | <0.6 | 16 |
| Selenium | µg/L | 12 | 0.5 | 0.2 | <0.5 | 0.8 | 26 | 1.1 | 30.7 | <0.5 | 92 |
| Zinc | µg/L | 12 | 1.5 | 0.9 | <1 | 2.5 | 22 | 3.4 | 4.0 | <0.5 | 16 |

n=number of samples; min=minimum value; max=maximum value; TSS=total suspended solids; DO=dissolved oxygen; N/A=not applicable

Prepared by: DG Checked by: CC

**Table 3.27 Baseline Parameters Above Guidelines in Marine Waters within the Boston and Doris Project Areas, 2008**

| Site | Date | Field pH | Total Suspended Soilds (mg/L) | Cadmium (Total) (µg/L) |
|---|---|---|---|---|
| | | CWQG 7.0 - 8.7 | | CWQG 0.120 µg/L |
| Hope Bay Bottom | 16-Jul-08 | 7.60 | 11 | **0.15** |

Prepared by: JM
Checked by: CC

CWQG=Canadian Water Quality Guideline.
TSS and pH are presented to help in interpretation of the values greater than the guidelines.
**Bolded values** exceed the CWQGs.

# 4 FISH POPULATIONS

The 2008 fisheries field program focused on the Boston and Madrid Project Areas. The program was largely designed to extend baseline data collection and confirm earlier findings reported by Rescan (RL&L/Golder 2002).

In the Boston Project Area, the south arm of Aimaokatalok Lake was sampled to confirm the fish species composition reported in previous studies (RL&L/Golder 2002). Captured lake trout were tagged to support future population studies. As well, electrofishing, angling, and seining were conducted in the Koignuk River. Efforts were focused on areas that were identified in 2007 and 2008 as possible spawning habitat for Arctic grayling (*Thymallus arcticus*).

In the Madrid Project Area, sampling was undertaken in Patch Lake to provide additional baseline data for the fish populations. This was the third year of sampling in Patch Lake. Windy Lake was sampled to confirm the fish species composition from earlier studies (RL&L/Golder 2002) and provide baseline data for the fish populations in the lake. The least cisco population in Wolverine Lake was sampled, and a small sub-set was retained to further examine the life history traits of the fish.

To reduce impacts of sampling on fish populations, non-lethal sampling techniques, such as backpack electrofishing, gill netting (short duration sets), beach seining, angling, and dip netting, were used to collect fish during the study program. At all fishing sites, length and weight were recorded for individual fish. These data were used to generate length-frequency plots and weight-length regressions. Length-frequency plots are used to determine whether certain sizes of the fish in the population are more dominant than would be expected from a statistically normal distribution. This can often indicate whether a population is stressed or not. For example, fish populations that are subject to over-fishing often have length-frequency plots that are skewed to the left; this means that younger fish are over-represented and older fish are under-represented. It can also indicate when sampling has not been adequate to fully characterize the population.

Weight-length regressions can be compared among years and populations of fish to identify differences in condition or growth patterns. The ‘condition’ of a fish refers to how heavy it is for its length. Fish condition and growth patterns were compared among years for lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), and cisco (*Coregonus artedi*) captured in Patch Lake and among lakes for lake trout, lake whitefish, and cisco captured in 2008.

## 4.1 METHODS

Fish sampling methods in selected lakes consisted of angling, backpack electrofishing, beach seining, fyke netting, gill netting, and minnow trapping (Figures 4.1 to 4.3). Data analyses involved descriptive statistics and statistical comparisons among lakes and among years for each species where possible. Detailed descriptions of the methods are provided below.

### 4.1.1 Angling

Angling was conducted by casting from shore. Barbless lures were used, and captured fish were processed for life history information before being released. Other recorded data included date and time of capture, UTM coordinates, hours fished, and number of rods used.

### 4.1.2 Backpack Electrofishing

A Smith-Root Model 12B backpack electrofisher was used to collect small bodied fish in lakes and streams. The operator waded upstream and sampled in the vicinity of suspected fish holding areas (e.g., around boulders); the netter collected stunned fish and placed them in a holding bucket to recover prior to processing for life history information, and subsequent release into the area of capture. Recorded information at each site included UTM coordinates, date and time of sampling, distance sampled, sampling effort (seconds), and electrofisher settings.

### 4.1.3 Beach Seining

Beach seining for small fish was conducted in shallow areas of lakes and streams. Suitable habitat for beach seining was selected along lake shorelines and in areas of fine substrate. The beach seine was 9 m long, with a mesh size of 6 mm, and was equipped with a collection bag with a mesh size of 3 mm. The length and effective width of each haul was recorded. Similar to the other sampling methods, life history information, UTM coordinates, date, and time were also recorded.

**LEGEND**

- CAMP
- BACKPACK ELECTROFISHING
- BEACH SEINING
- DIP NETTING
- GILL NETTING
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY

1500 0 1500

SCALE 1:50000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Assoicates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 FISH SAMPLING STATIONS**
**BOSTON PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 4.1**

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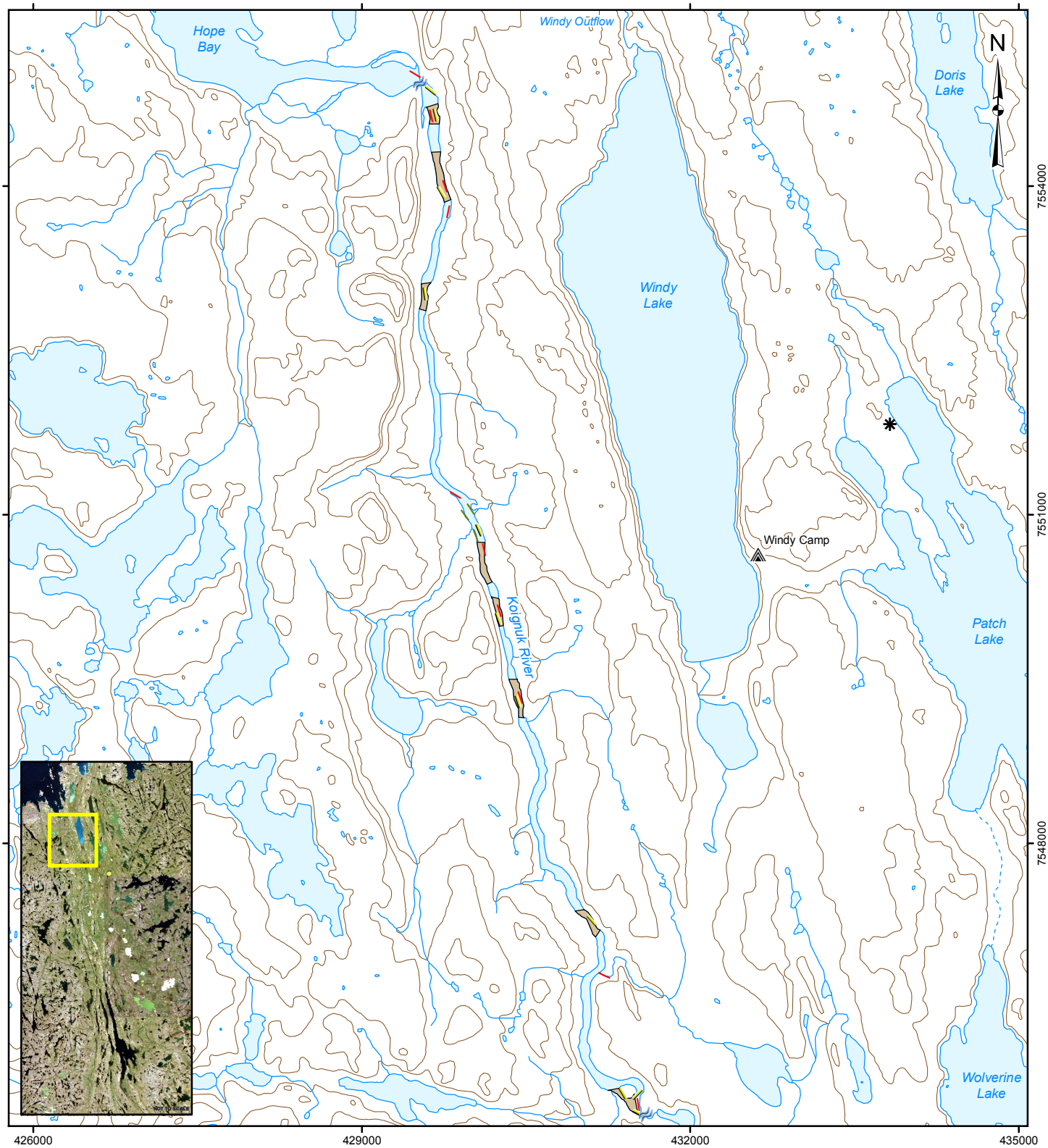


**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- ANGLING
- BACKPACK ELECTROFISHING
- BEACH SEINING
- RAPID
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY
- POTENTIAL ARCTIC GRAYLING SPAWNING HABITAT

1500 0 1500

SCALE 1:50000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 KOIGNUK RIVER FISH SAMPLING STATIONS AND POTENTIAL SPAWNING AREAS, BOSTON PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 4.2**

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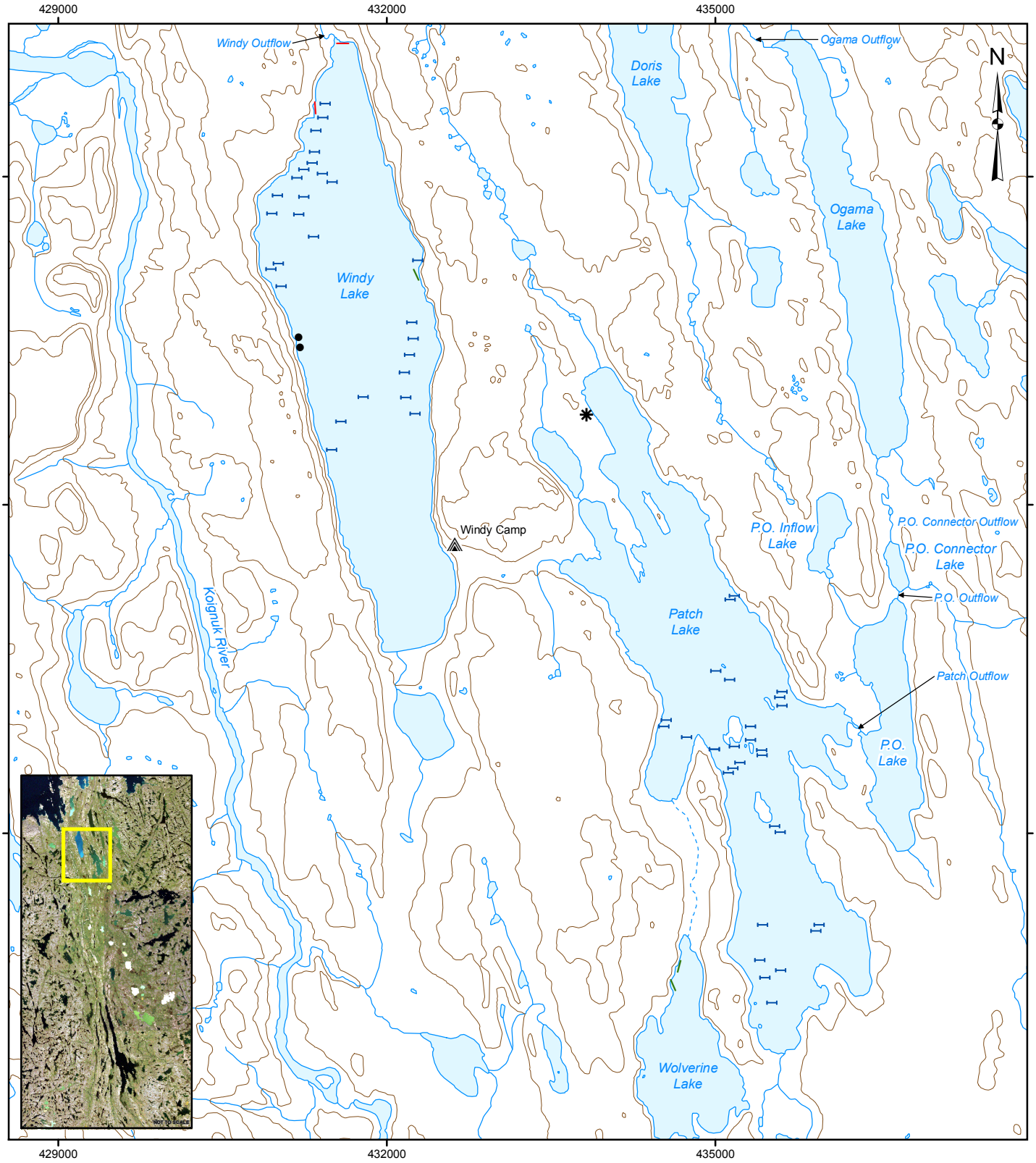


**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- BACKPACK ELECTROFISHING
- BEACH SEINING
- GILL NETTING
- MINNOW TRAPPING
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**2008 FISH SAMPLING STATIONS**
**MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
| DESIGN | AH | 23 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 4.3**

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### 4.1.4 Gill Netting

Variable mesh experimental gill nets were employed to sample large bodied fish. Each experimental gill net was composed of three panels measuring 15.2 by 1.8 m each. Mesh sizes were 3.81, 5.08, and 6.35 cm. Set times were limited to one to three hours to minimize capture related mortalities. Information recorded at each gill-net site included UTM coordinates, date and time of set and lift, and water depth.

### 4.1.5 Dip Netting

Dip netting was conducted in an attempt to collect larval and young-of-the-year (YOY) fish in selected high quality habitats in the Koignuk River and in nearshore rearing areas in the south arm of Aimaokatalok Lake. Dip-netting was performed by sweeping a small canvas kick net throughout areas of suitable fish habitat. Dip netting was also used to capture adult fish that were near the fish processing station in Aimaokatalok Lake.

### 4.1.6 Minnow Trapping

Gee minnow traps were used to sample small fish in lakes and streams in the Boston and Madrid Project Area. The traps (40 cm long, 23 cm diameter at the center, and 19 cm diameter at each end) were two-piece wire enclosures with inverted funnel openings. They were baited with pet food and were set in near-shore habitats. Date, time, UTM coordinates, and depth were recorded for all minnow trap sets.

### 4.1.7 Life History Data Collection

Life history information was collected from most captured fish. Fish were identified to species, measured (fork or total length to the nearest millimetre), and weighed (to the nearest gram). Additional life history data were collected from fish that died during sampling; data collected included sex, maturity, reproductive status, and stomach contents. Ageing structures were also collected from lake trout mortalities.

To facilitate data recording and presentation of results, all captured fish were assigned a four-letter species code. The common and scientific names of fish species captured in 2008, as well as the four-letter coded abbreviation, are presented in Table 4.1.

**Table 4.1 Common and Scientific Names of Fish Species Captured in the Hope Bay Belt, 2008**

| Common Name | Scientific Name[a] | Code |
|---|---|---|
| Arctic char | *Salvelinus alpinus* (Linnaeus) | ARCH |
| Arctic grayling | *Thymallus arcticus* (Pallus) | ARGR |
| Burbot | *Lota lota* (Linnaeus) | BURB |
| Cisco | *Coregonus artedi* Lesueur | CISC |
| Lake trout | *Salvelinus namaycush* (Walbaum) | LKTR |
| Lake whitefish | *Coregonus clupeaformis* (Mitchill) | LKWH |
| Least cisco | *Coregonus sardinella* Valenciennes | LSCS |
| Ninespine stickleback | *Pungitius pungitius* (Linnaeus) | NNST |
| Slimy sculpin | *Cottus cognatus* Richardson | SLSC |

[a] From Nelson et al. (2004)

## 4.1.8 Fish Tagging

In Aimaokatalok, Patch, and Windy lakes, captured lake trout were scanned with a PIT (passive integrated transponder) tag reader to determine if they had been previously tagged. Fish were also checked for uniquely numbered Hallprint T-bar anchor tags. For tagged fish, the tag number and type of tag was recorded and that fish was labelled as a 'recapture' for data entry. If the fish were not previously tagged, a PIT tag was inserted into the body cavity of each fish between the pelvic and pectoral girdles and scanned with the reader to ensure proper function prior to the release (Columbia Basin Fish and Wildlife Authority 1999). PIT tags and injectors were sterilized with diluted isopropyl alcohol prior to each use. Fish greater than 450 mm in length were also given a uniquely numbered Hallprint T-bar anchor tag. Tags were placed just below the dorsal fin of suitably-sized fish for quick visual identification.

## 4.1.9 Data Analysis

All life history data from individual fish were consolidated into tables (Appendix C1) and submitted to a thorough QA/QC procedure. The data were then used to calculate the following life history statistics:

- Length-frequency distributions;
- Weight-length relationships; and
- Summary statistics (mean, standard deviation, and range of length, weight, and condition factor data).

Condition and growth patterns for lake trout, lake whitefish, and cisco were compared among years in Patch Lake and among all populations in all lakes sampled in 2008. Historically, one of the most common ways to compare condition is to use Fulton's condition factor (K) (Fulton 1904), calculated as follows:

$$K = 100\,000*W/L^3$$

where length (L) is fork or total length in millimeters and weight (W) is in grams. If *K* is close to, or equal to 1, fish growth is near isometric. This means that growth in weight relative to length is close to what would be predicted (i.e., weight is a function of the cube of length).

A second, more contemporary way to analyze fish growth patterns is to use weight-length regressions. The relationship between fish weight and length is curvilinear and can be represented by the following equation:

$$W = aL^b$$

where W is weight in grams, L is fork or total length in millimetres, 'a' is a constant, and 'b' is an exponent that is usually between 2.5 and 4.0 (Ricker 1971; Pope and Kruse 2007). If the relationship is log-transformed, 'a' and 'b' are the intercept and slope, respectively, of a linear relationship (Ricker 1971; Wootton 1990; Jobling 1994). The slope of the log-transformed regression and the exponent of the non-linear regression indicate the rate of change of weight with length and indicates how the shape of the fish changes with size. If the slope or exponent is approximately 3, growth is isometric and the shape of the fish does not change with size. If the slope or exponent are less than or greater than 3, growth is allometric and the fish is either becoming lighter or heavier for its length (this appears visually as the fish being more or less rotund (Ricker 1971). Statistical comparison of the slopes of weight-length regressions among populations or years, therefore, can reflect differences in condition and growth patterns (Mackay et al. 1990; Wootton 1990). This method is thought to be preferable to the calculation and comparison of traditional condition indices (Wootton 1990).

Comparison of slopes (b) among populations and years was achieved by using an Analysis of Covariance (ANCOVA) model. In ANCOVA analysis, fish weight is modeled as a function of fish length and a categorical variable, such as lake or year. There is also an interaction term. For example, if fish weight is being modeled as a function of fish length and lake, the interaction term is lake*length. If this interaction term is significant, the linear regression between weight and

length differs among populations, then can be used to make predictions of how heavy a fish is at a specified length in each lake. These predicted values are called least-squared means.

As an index of relative abundance, catch-per-unit-effort (CPUE) values were calculated for each sampling method. Caution is necessary in interpreting these results since CPUE is not necessarily proportional to abundance. The CPUE values calculated will only provide a measure of the component of the population that is vulnerable to the gear (Maunder et al. 2006).

CPUE values for minnow trap catches are standardized to number of fish captured per 24 hours of trap operation. CPUE values for gill net sets are standardized to number of fish captured per 100 $m^2$ of mesh panel set per 24 hours. CPUE values for angling are standardized to number of fish captured per hour of angling with one rod. Backpack electrofishing CPUE values are standardized to number of fish per 100 seconds, and beach seining CPUE units are standardized to number of fish per 100 $m^2$ of area seined.

The catch and size statistics for fish sampled during the sampling program are summarized in Appendices C2 to C9; data from individual fish are presented in Appendix C1.

## 4.2 BOSTON PROJECT AREA LAKE COMMUNITIES

### 4.2.1 Aimaokatalok Lake

Fish sampling was conducted in Aimaokatalok Lake from 1 to 5 August 2008. Fish capture methods used to document species composition and abundance consisted of backpack electrofishing, seine netting, dip netting, and gill netting.

#### 4.2.1.1 Species Composition and Relative Abundance

In total, 393 fish representing six species (lake trout, cisco, lake whitefish, least cisco, slimy sculpin, and ninespine stickleback) were captured in Aimaokatalok Lake in 2008 (Table 4.2). Previous studies conducted by Rescan Environmental between 1993 and 1997 indicated the presence of lake trout, lake whitefish, cisco, and Arctic grayling in Aimaokatalok Lake (Golder 2008a), and a study conducted by Golder Associates in 2006 indicated the presence of lake trout, cisco, and ninespine stickleback (Golder 2008b). Arctic grayling were not captured during the 2008 or 2006 Golder sampling programs but if they are present, there would be seven fish species present in Aimaokatalok Lake. In 2008, an unidentified YOY coregonid species (cisco or lake whitefish) was the predominant species in the

overall catch (46.6%), followed by ninespine stickleback (20.1%), lake whitefish (14.2%), and lake trout (10.2%). This is expected in healthy lakes; forage fishes should dominate the catch, whereas predatory fishes should be less abundant. CPUE data for Aimaokatalok Lake are presented in Appendices C5 to C8. Beach seining conducted along shoreline habitats resulted in the largest number of fish captured. Gill net sets provided the greatest variety of species captured.

**Table 4.2 Fish Species and Number Captured in Aimaokatalok Lake, 2008**

| Capture Method | Cisco | Lake Trout | Lake Whitefish | Least Cisco | Ninespine Stickleback | Slimy Sculpin | Unidentified Coregonid | Total |
|---|---|---|---|---|---|---|---|---|
| Beach seine | | | | | 13 | | 183 | **196** |
| Backpack electrofishing | | | | | 52[a] | 2 | | **54** |
| Dip net | | 1 | | | 14 | | | **15** |
| Gill nets | 13 | 39 | 56[b] | 20 | | | | **128** |
| **Total** | **13** | **40** | **56** | **20** | **79** | **2** | **183** | **393** |
| | **3.3%** | **10.2%** | **14.2%** | **5.1%** | **20.1%** | **0.5%** | **46.6%** | **100.0%** |

[a] 51 additional observed.

[b] two additional observed.

Prepared by: AH Checked by: HS

## 4.2.1.2 Life History Data

### *Cisco and least cisco*

Cisco and least cisco captured in Aimaokatalok Lake were of very similar size and varied from 169 to 234 mm and 178 to 240 mm in fork length, respectively (Appendix C2). Mean condition factors for the two species were identical and very close to the predicted value of '1' (1.02; Appendix C2). When fish weight was regressed against length, the exponent was 2.70 for cisco (Figure 4.4) and 3.47 for least cisco (Figure 4.5). These exponent values are the same as the slope values for the log-transformed data. This seems to indicate that cisco have negative allometric growth and are skinnier as they increase in length, whereas least cisco have positive allometric growth and grow fatter as they increase in length. It should be noted, however, that the regression for least cisco is heavily influenced by the largest fish (which is substantially larger than most of the captured fish). Increased sampling would refine exponent estimates and resolve whether growth patterns really do differ between the two cisco species, or whether the observed difference is an artifact of the size distribution that was sampled.

Length-frequency plots were unimodal for both least cisco and cisco captured in Aimaokatalok Lake (Figures 4.6 and 4.7).

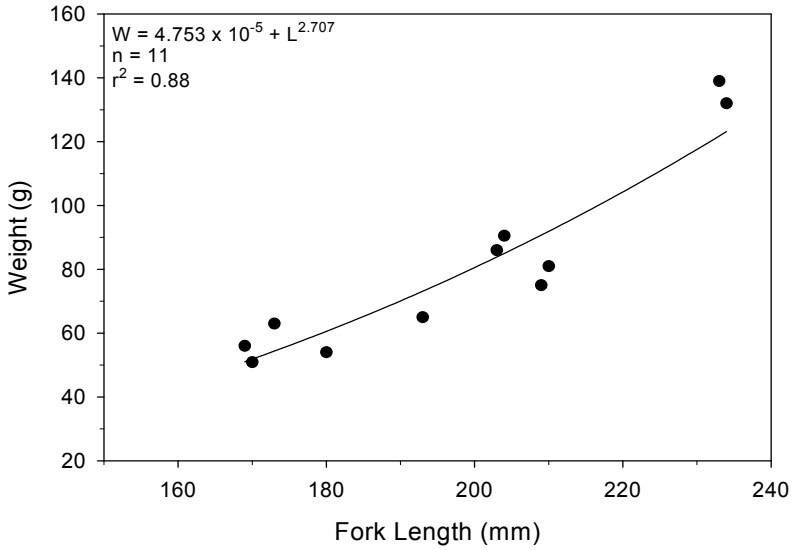



**Figure 4.4 Weight-Length Relationship of Cisco in Aimaokatalok Lake, 2008**

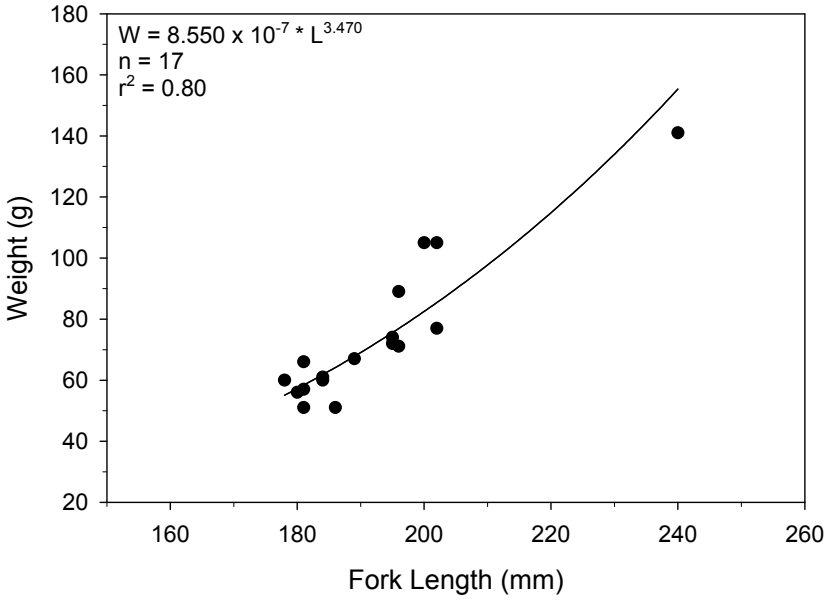



**Figure 4.5 Weight-Length Relationship of Least Cisco in Aimaokatalok Lake, 2008**

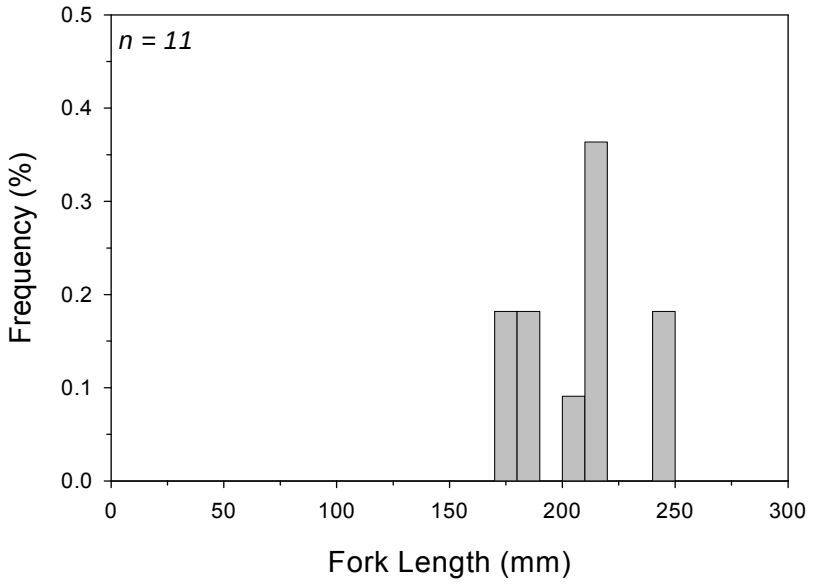



**Figure 4.6 Length-Frequency Distribution of Cisco in Aimaokatalok Lake, 2008**

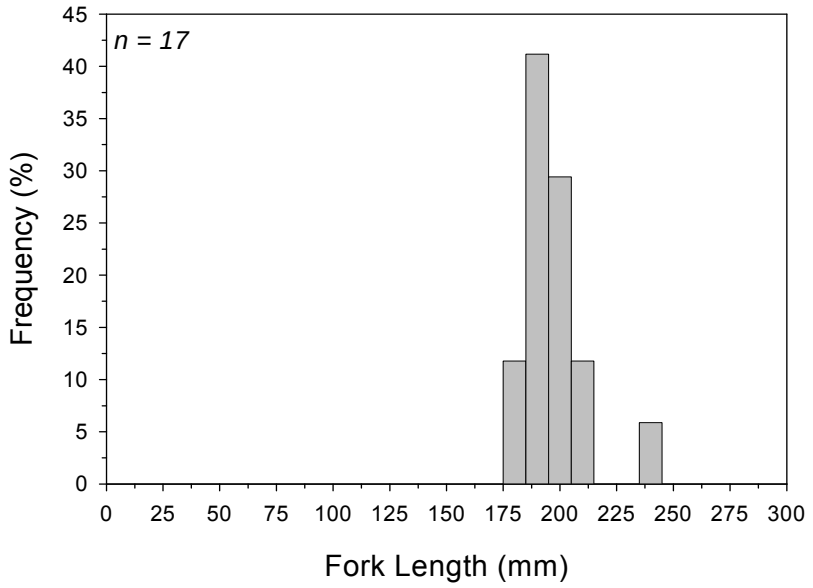



**Figure 4.7 Length-Frequency Distribution of Least Cisco in Aimaokatalok Lake, 2008**

### *Lake trout*

In 2006, only one adult lake trout was captured in Aimaokatalok Lake (Golder 2008b). During the 2008 sampling, however, larger fish dominated the catch; 36 of the 40 captured fish were > 400 mm (Appendix C1). Captured lake trout varied from 188 mm to 900 mm in fork length and 62 to 6706 g in weight (Appendix C2). The mean condition factor (*K*) for lake trout from Aimaokatalok Lake was 0.99 ± 0.15 (a value of 1 indicates isometric growth). When fish length and weight were regressed, the value of the exponent was 2.911 (Figure 4.8). As mentioned above, if the slope or exponent is 3 (or condition factor is 1), fish growth is exactly isometric. Thus, fish growth in Aimaokatalok Lake is slightly less than isometric, which means that the fish are slightly skinnier as they grow longer.

The length-frequency plot of lake trout captured in 2008 (Figure 4.9) indicates modes at 200 mm, 300-350 mm, 525-575 mm, 800 mm, and 900-950 mm. Smaller size classes are under-represented due to the small sample size.

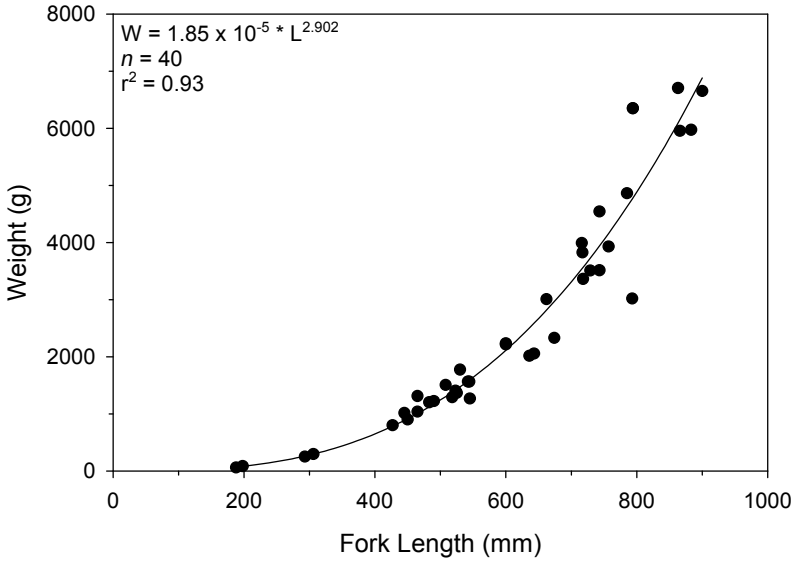



**Figure 4.8 Weight-Length Relationship of Lake Trout in Aimaokatalok Lake, 2008**

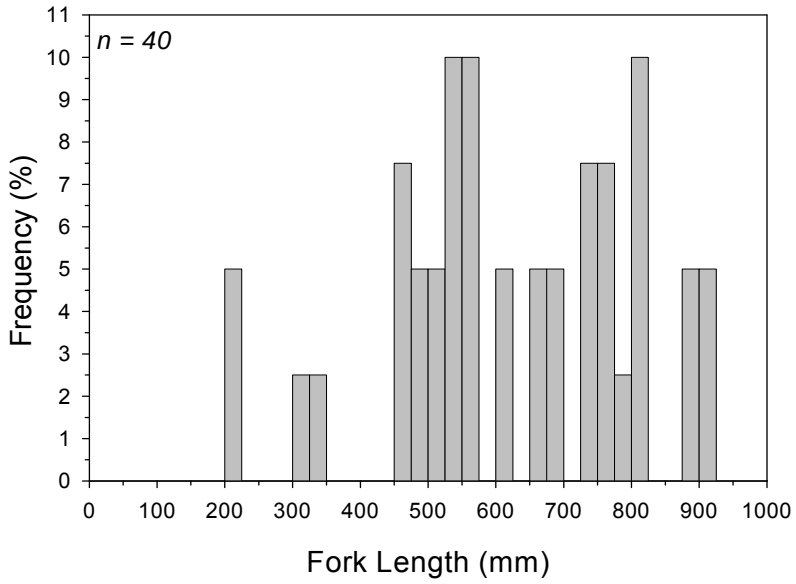



**Figure 4.9 Length-Frequency Distribution of Lake Trout in Aimaokatalok Lake, 2008**

### *Lake whitefish*

Lake whitefish captured in 2008 ranged from 191 to 501 mm fork length and from 79 to 1860 g wet weight (Appendix C2). Mean condition factor was 1.27 ± 0.15 (Appendix C2) and indicated that the fish are heavy for their length. This has been observed in previous years and in other lakes in the Hope Bay Belt (e.g., Golder 2008b). The exponent of the non-linear Weight-Length regression was 3.129 (Figure 4.10). This indicates that growth is allometric and the lake whitefish are getting fatter as they grow longer. It should be noted, however, that this exponent is influenced heavily by the two small lake whitefish captured; an increased sample size for small lake whitefish would likely improve the accuracy of this estimate (Figures 4.10 and 4.11). One fish appears to be an outlier, with a greater weight for its length relative to other lake whitefish; however, this fish was noted to be visibly heavy at the time of sampling.

The length-frequency plot for lake whitefish captured in 2008 (Figure 4.11) was skewed to the right. This could indicate density-dependence and strong older year-classes, or it could be an artifact of sampling that is biased toward larger-bodied fish.

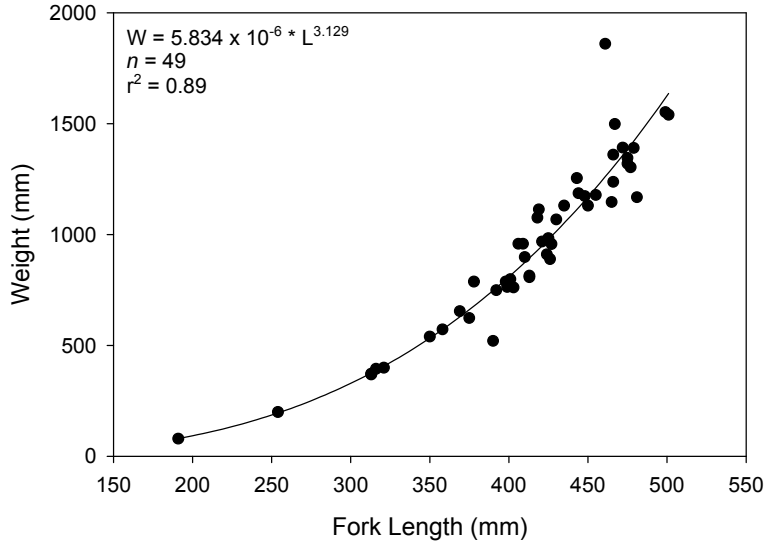



**Figure 4.10 Weight-Length Relationship of Lake Whitefish in Aimaokatalok lake, 2008**

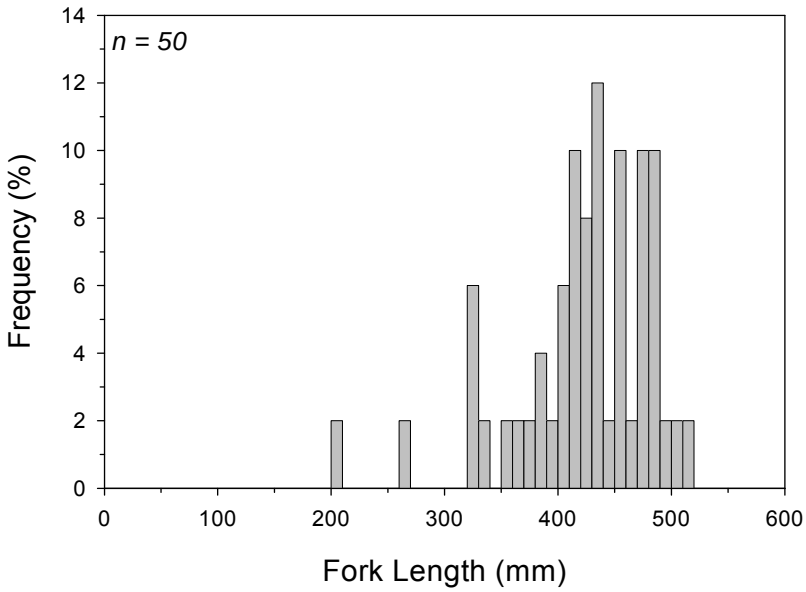



**Figure 4.11 Length-Frequency Distribution of Lake Whitefish in Aimaokatalok Lake, 2008**

### *Ninespine stickleback*

Ninespine stickleback captured in Aimaokatalok Lake ranged from 20 to 59 mm fork length (Appendix C2). This is slightly larger than the size range captured in 2006 (Golder 2008b). The length frequency plot indicated a unimodal distribution. Unlike some of the larger fish species, it is likely that the entire size range of ninespine stickleback captured in Aimaokatalok Lake is representative of the population (Figure 4.12).

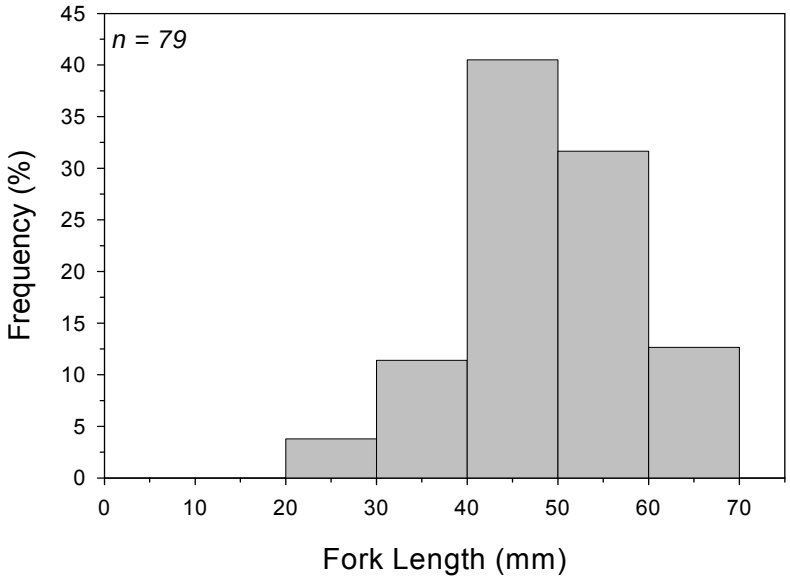



**Figure 4.12 Length-Frequency Distribution of Ninespine Stickleback in Aimaokatalok Lake, 2008**

### *Slimy sculpin*

Only two slimy sculpin were captured in Aimaokatalok Lake in 2008. They were 33 and 69 mm in length, respectively (Appendix C2). Weights were not obtained for these fish, so condition factors were not be calculated.

### *Coregonid species*

In total, 183 unidentified YOY coregonid fish were captured by seine netting along a shallow sandbar. These fish are believed to be lake whitefish.

A subset of 67 fish were measured. The remaining fish were not measured to reduce handling time and mortality due to low stress tolerance in these small fish. The lengths ranged from 22 to 41 mm (Appendix C2).

## 4.2.2 Koignuk River

Fish were sampled in the Koignuk River downstream of the outflow from Aimaokatalok Lake from 14 to 16 July 2008. The goal of the 2008 sampling was to determine if spawning Arctic grayling or YOY could be captured. Potential spawning areas identified in 2007 were the focus of the 2008 sampling effort (Figure 4.2). Fish capture methods consisted of angling, beach seining, and backpack electrofishing.

### 4.2.2.1 Species Composition and Relative Abundance

Fish sampling in the Koignuk River yielded a total of 72 fish representing four species, one of which was an adult Arctic grayling that was observed but not captured (Table 4.3). In contrast, the combined 2006 and 2007 sample catch yielded 10 species, including lake whitefish, lake trout, fourhorn sculpin, Arctic flounder, and Arctic char. The difference in number of captured species can be attributed to the fact that sampling in 2008 was specifically directed at Arctic grayling. The dominant species in the 2008 overall catch was ninespine stickleback (62.5%). Slimy sculpin, Arctic grayling, and burbot contributed 26.4%, 9.7%, and 1.4% of the overall catch, respectively (Table 4.3).

**Table 4.3 Fish Species and Number of Fish Captured in Koignuk River, 2008**

| Capture Method | Arctic Grayling | Burbot | Ninespine Stickleback | Slimy Sculpin | Total |
|---|---|---|---|---|---|
| Backpack electrofishing | 6 | 1 | 45[b] | 19[c] | 71 |
| Angling | 1[a] | | | | 1 |
| **Total** | **7** | **1** | **45** | **19** | **72** |
| | **9.7%** | **1.4%** | **62.5%** | **26.4%** | **100.0%** |

Prepared by: AH
Checked by: HS

[a] this fish was observed but not captuerd.
[b] five additional observed but not captured.
[c] four additional observed but not captured.

Adult Arctic grayling were not captured but one was observed; however, six juvenile Arctic grayling were captured. The low capture success for adult, spawning Arctic grayling may be partially due to high, turbid flow conditions in Koignuk River during the sampling period. Fast-flowing, turbid conditions substantially decrease the success of backpack electrofishing because the field crew is unable to see all of the fish that have been stunned. As well, there is a

greater chance that fish will move out of the field of the netter when flows are high. Repeat sampling for spawning Arctic grayling will likely be necessary, but should be conducted earlier in the open water season, when the water temperature is lower, if flows permit.

CPUE data for the Koignuk River are presented in Appendices C4 to C6. Backpack electrofishing had the highest CPUE values and captured primarily small bodied fish species. As mentioned, turbidity likely decreased catchability of fish for all gear types used.

#### 4.2.2.2 Life History Data

##### *Arctic grayling*

Seven Arctic grayling were captured or observed in the Koignuk River in 2008. Six of these were juveniles, which were captured with a backpack electrofisher in two of the potential Arctic grayling spawning areas identified in 2007. The only adult Arctic grayling was observed, but not captured, while angling at the downstream end of a riffle. The captured juvenile Arctic grayling did not vary much in size (50 to 64 mm; Appendix C2). Weights and condition factors are not available for these fish. A length-frequency plot was not generated for Arctic grayling due to the small sample size.

##### *Burbot*

One adult burbot was captured in Koignuk River in 2008. This is only the second adult burbot caught in the Hope Bay area since fish sampling began in the 1990s. The other adult was captured in Fickle Duck outflow in 2006 (Golder 2008b). The captured burbot was 468 mm in length and weighed 750 g (Appendix C2). The condition factor for this fish was 0.73, which is within the range (0.63 to 1.22) reported by Carlander (1969). The adult burbot caught in 2006 had a lower condition factor (0.69; Golder 2008b) than the burbot captured in 2008.

##### *Ninespine stickleback*

Forty-five ninespine stickleback were captured in Koignuk River in 2008 (Table 4.3). The fish ranged in length from 21 to 73 mm (Appendix C2). The length-frequency distribution seems to indicate that smaller fish were under-represented in the sample (Figure 4.13).

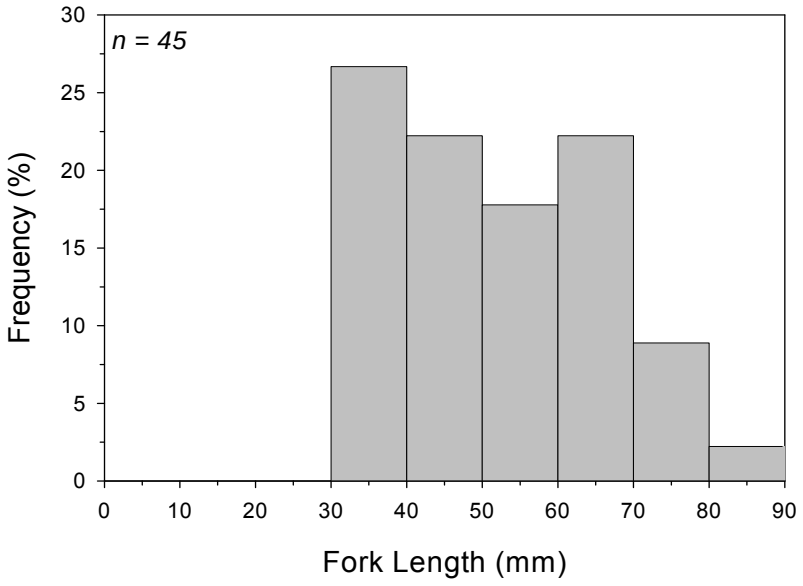



**Figure 4.13 Length-Frequency Distribution of Ninespine Stickleback in Koignuk River, 2008**

### *Slimy sculpin*

Nineteen slimy sculpin were captured in the Koignuk River in 2008. They represented a much larger proportion of the catch (26.4%) than they did in 2006 and 2007 (1.5%; Golder 2008b). This was likely due to differences in capture techniques between the two years.

Lengths for individual fish ranged from 21 to 73 mm (Appendix C2). The length-frequency distribution was unimodal but seemed to indicate that there may be slightly larger fish that were not sampled (Figure 4.14).

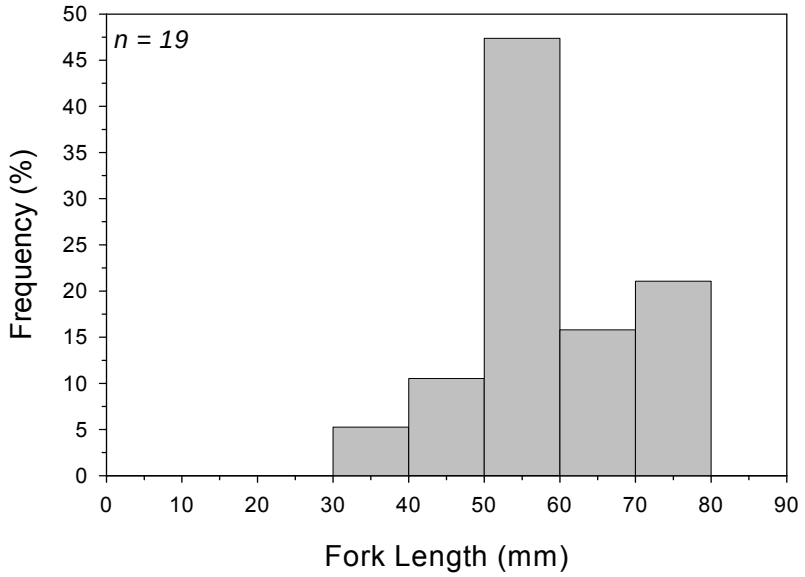



**Figure 4.14 Length-Frequency Distribution of Slimy Sculpin in Koignuk River, 2008**

## 4.2.3 Boston Project Area Summary

During the 2008 sampling program, 465 fish representing eight species were encountered in the Boston Project Area (Table 4.4). Fish sampling was conducted in the south arm of Aimaokatalok Lake and in the Koignuk River. The most abundant fish species captured was a YOY coregonid species captured while seining in a shallow sandy area of Aimaokatalok Lake (39.4%). These fish are believed to be lake whitefish. Ninespine stickleback contributed 26.7% of the catch, lake whitefish contributed 12.0%, and lake trout contributed 8.6% of the catch (Table 4.4). Slimy sculpin, least cisco, cisco, Arctic grayling, and burbot contributed less than 5% each to the total catch (Table 4.4).

**Table 4.4 Summary of Fish Captured in the Boston Project Area, 2008**

| Waterbody | Cisco | Lake Trout | Lake Whitefish | Least Cisco | Ninespine Stickleback | Slimy Sculpin | Coregonid Spp. | Arctic Grayling | Burbot | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Aimaokatalok Lake | 13 | 40 | 56 | 20 | 79 | 2 | 183 | | | **393** |
| Koignuk River | | | | | 45 | 19 | | 7 | 1 | **72** |
| **Total** | **13** | **40** | **56** | **20** | **124** | **21** | **183** | **7** | **1** | **465** |
| | **2.8%** | **8.6%** | **12.0%** | **4.3%** | **26.7%** | **4.5%** | **39.4%** | **1.5%** | **0.2%** | **100.0%** |

Prepared by: AH
Checked by: HS

# 4.3 MADRID PROJECT AREA

## 4.3.1 Patch Lake

Fish sampling was conducted in Patch Lake on five days between 19 and 25 July 2008. As mentioned in the introduction, the primary purpose of this sampling was to continue the mark-recapture program for lake trout that was initiated in 2006. Continued sampling will allow more accurate estimates of the lake trout population in Patch Lake in the future. Fish capture was achieved exclusively with gill nets.

### 4.3.1.1 Species Composition and Relative Abundance

In Patch Lake, 153 fish representing four species (lake trout, cisco, lake whitefish, and least cisco) were captured in 2008 (Table 4.5). The species that dominated the catch were cisco (45.8%) and lake whitefish (33.3%), whereas lake trout and least cisco represented 17.7% and 3.3% of the catch, respectively. As mentioned in the above discussion for Aimaokatalok Lake, forage (prey) fish species are often present at higher abundances than predatory species, so it is not unusual to encounter large numbers of non-target species when fishing for lake trout.

CPUE data for gill netting efforts in Patch Lake are presented in Appendix C8. Short gill net sets were appropriate for targeting the fish species of interest and minimizing mortality due to netting influences. CPUE for lake trout, the main target species, was lower than for coregonid species, such as cisco and lake whitefish. This is likely due to differences in population abundance of the coregonid spcies and the movement and aggregation strategies between lake trout and coregonid species, and corresponding vulnerability to the gear.

**Table 4.5 Fish Species and Number Captured in Patch Lake, 2008**

| Capture Method | Cisco | Lake Trout | Lake Whitefish | Least Cisco | Total |
|---|---|---|---|---|---|
| Gill netting | 70[a] | 27[b] | 51[c] | 5 | 153 |
| | **70** | **27** | **51** | **5** | **153** |
| **Total** | **45.8%** | **17.7%** | **33.3%** | **3.3%** | **100.0%** |

Prepared by: AH
Checked by: HS

[a] four additional observed but not captured.
[b] two additional observed but not captured.
[c] one additional observed but not captured.

### 4.3.1.2 Life History Data

#### *Lake trout*

Fork lengths for the 27 lake trout captured in 2008 ranged from 263 to 935 mm, and weights ranged from 186 to 11 000 g (Appendix C2). This was very similar to the range of fork lengths captured in 2006 and 2007, despite the fact that the sample size in 2008 was 10% of that in 2006 and 2007 (this was due to substantially decreased sampling effort). The mean condition factor (*K*) for lake trout from Patch Lake was 0.99. This is exactly the same mean condition factor as was found for lake trout from Aimaokatalok Lake (Section 4.2.1; Appendix C7). The exponent was 3.15 for non-linear regression of length and weight (Figure 4.15), which indicates that fish growth is positively allometric, which means that they become increasingly heavier as they grow longer. This can sometimes indicate that larger fish have access to higher quality prey (i.e., small fish prey) than smaller fish (i.e., invertebrate prey). In Patch Lake, it is likely that there is a critical size (sometimes called an escape size) where lake trout switch from benthivorous feeding (feeding on invertebrates such as *Saduria entomon* and Chironomid spp.) to piscivorous and cannibalistic feeding. Extreme cases of cannibalism have already been noted in some lake trout in Patch Lake (H. Swanson, unpublished data), where large lake trout were feeding on fish up to one third their own size.

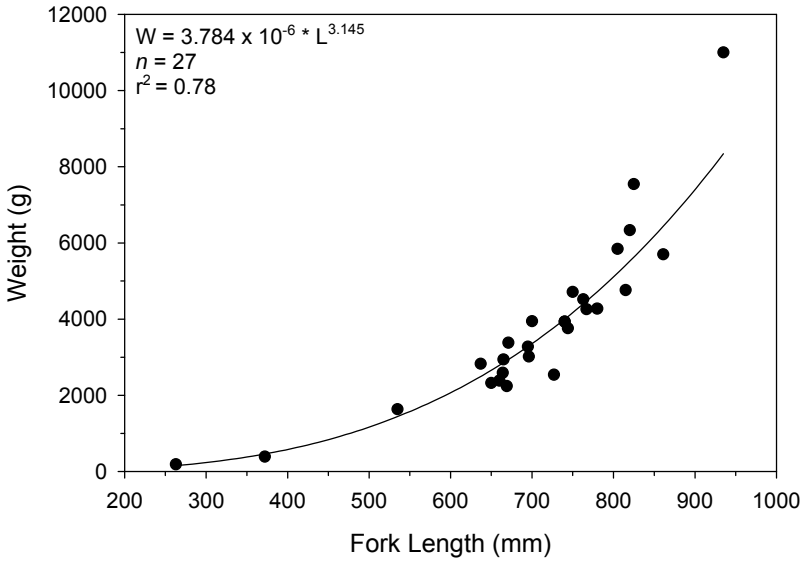



**Figure 4.15 Weight-Length Relationship of Lake Trout in Patch Lake, 2008**

The length-frequency plot for lake trout from Patch Lake was unimodal but was skewed to the right (Figure 4.16). This indicates that the sampling efforts were biased toward larger fish (i.e., the juvenile lake trout often position themselves in shallow water near shore or move into small tributary streams during the open water period to avoid predation by larger adult lake trout).

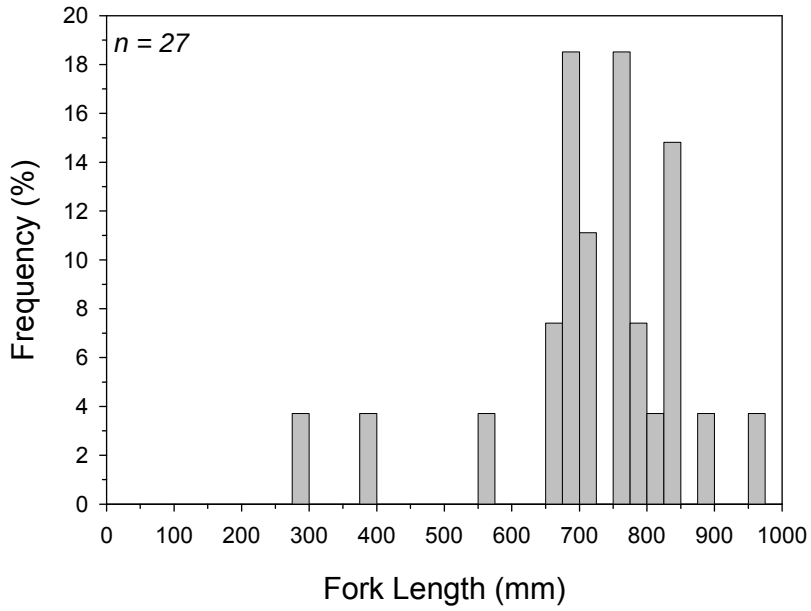



**Figure 4.16 Length-Frequency Distribution of Lake Trout in Patch Lake, 2008**

### *Cisco*

Cisco captured in Patch Lake in 2008 ranged from 166 to 326 mm in fork length and from 43 to 348 g in wet weight (Appendix C2). Mean condition was 0.97, which is very close to the expected value of 1. The mean condition of cisco from Patch Lake was slightly lower, however, than the mean condition of cisco in either Aimaokatalok Lake or Windy Lake (Appendix C2). A power regression of weight against length revealed an exponent of 2.49 (Figure 4.17). This indicates that the cisco in Patch Lake get thinner as they grow longer (i.e., negative allometric growth). The condition factors for individuals were variable due to visible differences in fish weight (i.e., several fish were notably skinnier than others for a given length) (Figure 4.17).

The length-frequency plot for cisco from Patch Lake was unimodal and approximated a normal distribution (Figure 4.18). It is likely that the smallest fish are under-represented because gill netting usually does not yield YOY or year 1+ captures.

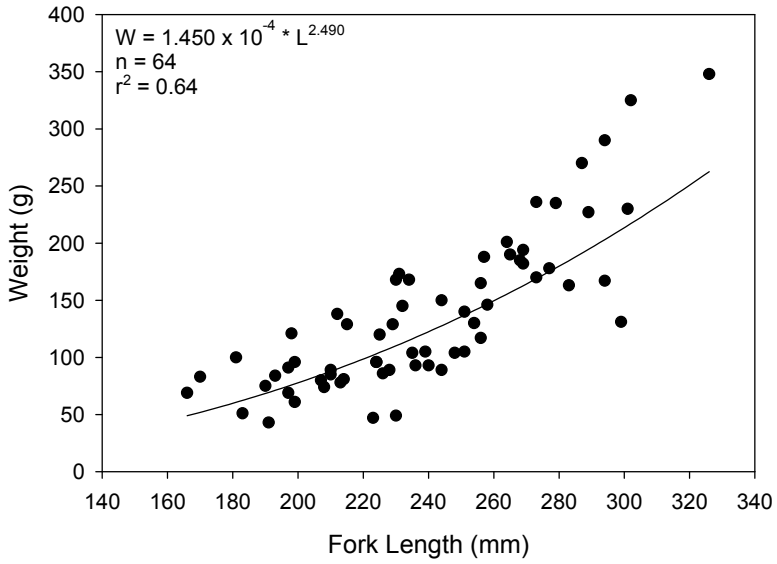



**Figure 4.17 Weight-Length Relationship of Cisco in Patch Lake, 2008**

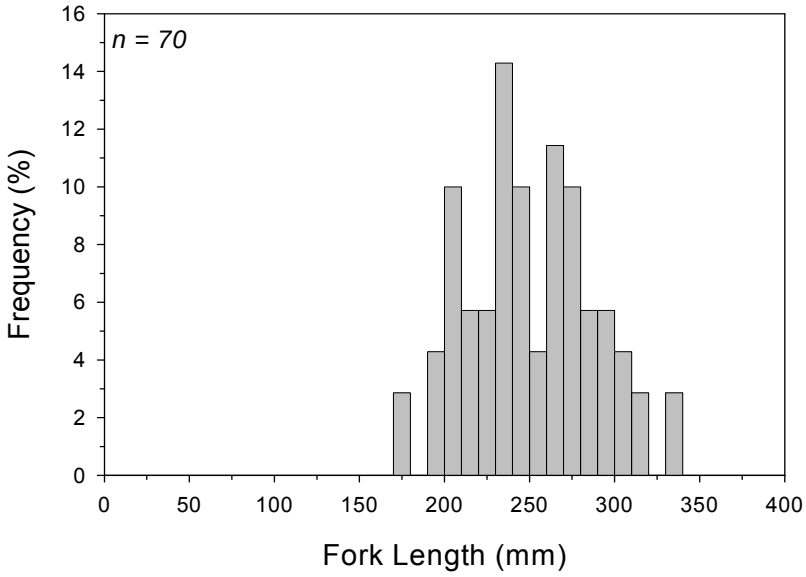



**Figure 4.18 Length-Frequency Distribution of Cisco in Patch Lake, 2008**

### *Least cisco*

The five least cisco captured in Patch Lake ranged from 200 to 246 mm in fork length and from 58 to 119 g in wet weight (Appendix C2). They were approximately the same size as those captured in Aimaokatalok Lake, but were much larger than those caught in Wolverine Lake. Mean condition factor was 0.77, which means that they are light for their length. Mean condition was lower in Wolverine Lake but higher in Aimaokatalok Lake. This likely represents differences in food sources and prey availability.

Weight-length and length-frequency analyses were not completed for least cisco captured in Patch Lake due to low sample size.

### *Lake whitefish*

Fifty-one lake whitefish were captured in Patch Lake during 2008 sampling. These fish ranged in length from 241 to 465 mm and in weight from 92 to 1435 g (Appendix C2). In contrast, the largest lake whitefish captured during the 2006 and 2007 sampling was 615 mm. This, along with the length-frequency plot (Figure 4.19), indicates that large lake whitefish were under-represented in the 2008 sampling program.

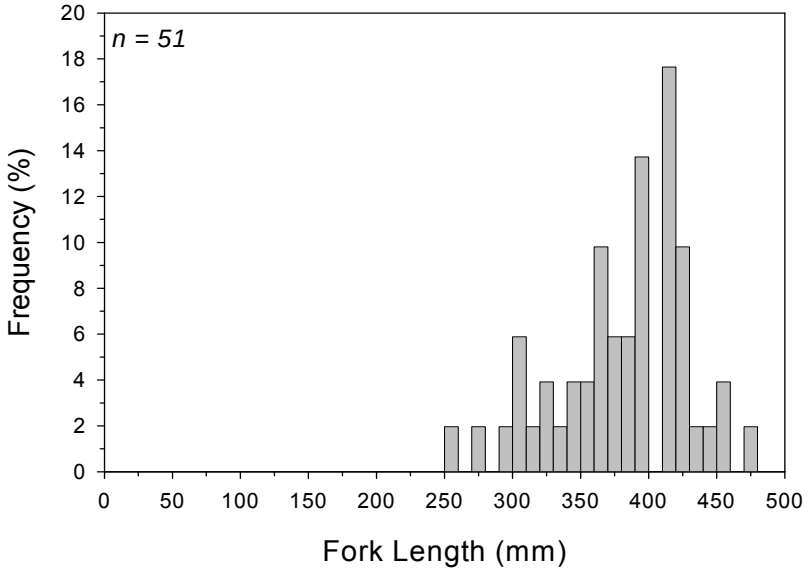



**Figure 4.19 Length-Frequency Distribution of Lake Whitefish in Patch Lake, 2008**

Mean condition factor for lake whitefish in Patch Lake was 1.22 (Appendix C2). This was similar to the mean observed in Aimaokatalok Lake (1.27; Section 4.2.1; Appendix C7). It seems, therefore, that lake whitefish in the Hope Bay area are heavy relative to their length. A power regression of weight against length revealed an exponent of 3.53 (Figure 4.20). Growth is therefore positively allometric and the lake whitefish in Patch Lake grow fatter with increased length.

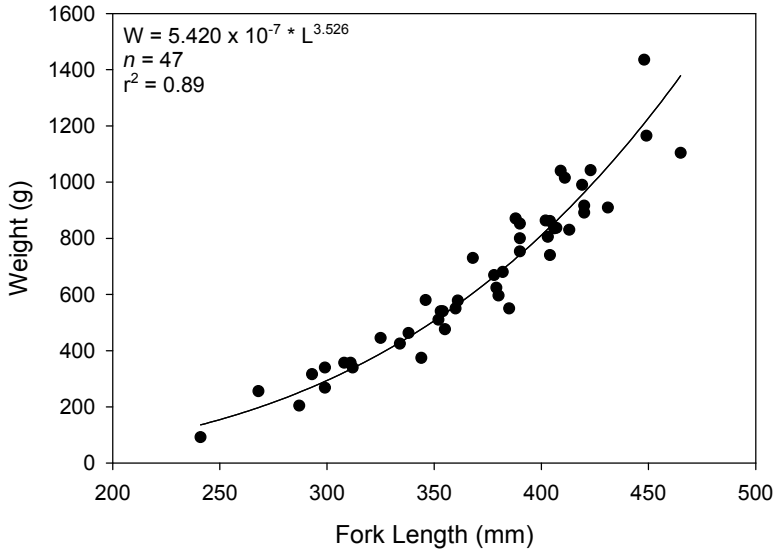



**Figure 4.20 Weight-Length Relationship of Lake Whitefish in Patch Lake, 2008**

## 4.3.2 Windy Lake

Fish sampling was conducted in Windy Lake from 6 to 8 August 2008. The purpose of this sampling was to confirm the fish species composition documented in earlier studies (RL&L/Golder 2002) and to provide baseline information for the lake due to its proximity to the proposed future mine development on Patch Lake. Sampling was accomplished by backpack electrofishing, beach seining, gill netting, and minnow trapping.

### 4.3.2.1 Species Composition and Relative Abundance

In 2008, 264 fish representing three species (lake trout, cisco, and ninespine stickleback) were captured in Windy Lake (Table 4.6). Lake whitefish were not captured during the 2008 sampling but they were captured by Rescan Environmental in 1996 and 1997 (RL&L/Golder 2002). Further sampling may be necessary to

determine the relative abundance and preferred location of lake whitefish in Windy Lake.

Cisco dominated the catch (86.0%) in the 2008 sampling, followed by lake trout (11.7 %) and ninespine stickleback (2.3%). This is similar to many other lakes in the area; cisco often dominate the catch, particularly when gill netting is employed as the primary capture technique. CPUE data for sampling effort on Windy Lake are presented in Appendices C5 to C6 and C8 to C9. Successful capture of fish was only obtained using backpack electrofishing and gill netting.

**Table 4.6 Fish Species and Number Captured in Windy Lake, 2008**

| Capture Method | Cisco | Lake Trout | Ninespine Stickleback | Total |
|---|---|---|---|---|
| Backpack elecrofishing | | 4 | 6 | 10 |
| Gill netting | 227 | 27 | | 254 |
| **Total** | **227** | **31** | **6** | **264** |
| | **86.0%** | **11.7%** | **2.3%** | **100.0%** |

Prepared by: AH
Checked by: HS

## 4.3.2.2 Life History Data

### *Lake trout*

The 31 lake trout captured in Windy Lake reflected a large size range; they ranged from 68 to 1000 mm in fork length and from 3 to 11,500 g in wet weight (Appendix C2). The mean length was 481 mm, which is very close to the mean length of 476 mm documented during previous studies in 1996 and 1997 (RL&L/Golder 2002). Mean condition for lake trout captured in 2008 was 1.08, which, again, is very similar to the value of 1.10 that was found during previous sampling programs conducted in 1996 and 1997 (Appendix C2; RL&L/Golder 2002).

Power regressions of weight against length yielded an exponent value of 3.12 (Figure 4.21). This indicates positive allometric growth, where the fish grow fatter as they increase in length, and is very similar to the exponent value found for lake trout in Patch Lake (Figure 4.15). In contrast, analyses performed on the lake trout captured in 1996 and 1997 revealed an exponent value of 2.94, which indicates slight negative allometric growth. The difference may be due to variability in sample size (31 in 2008 vs. 77 in 1996 and 1997), natural year-to-year variability, or an increase in prey availability for larger fish in Windy Lake. Differences in sample sizes seems to be the most plausible explanation.

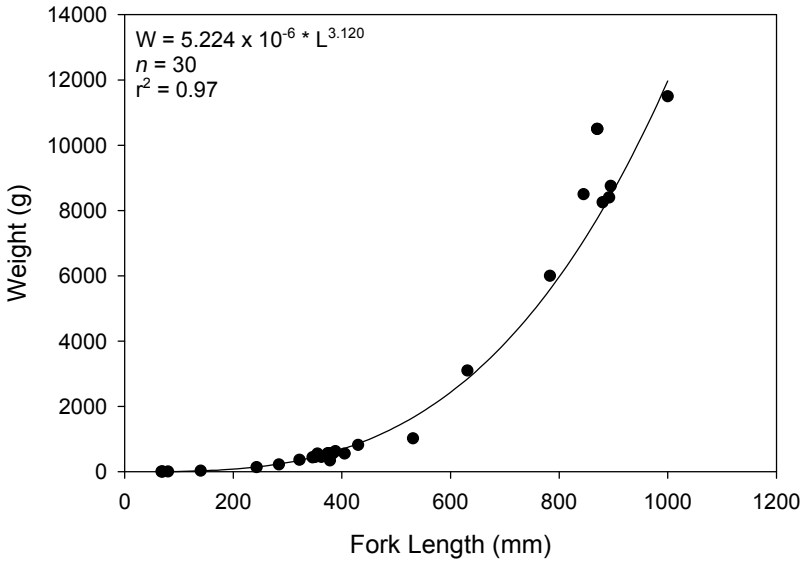



**Figure 4.21 Weight-Length Relationship of Lake Trout in Windy Lake, 2008**

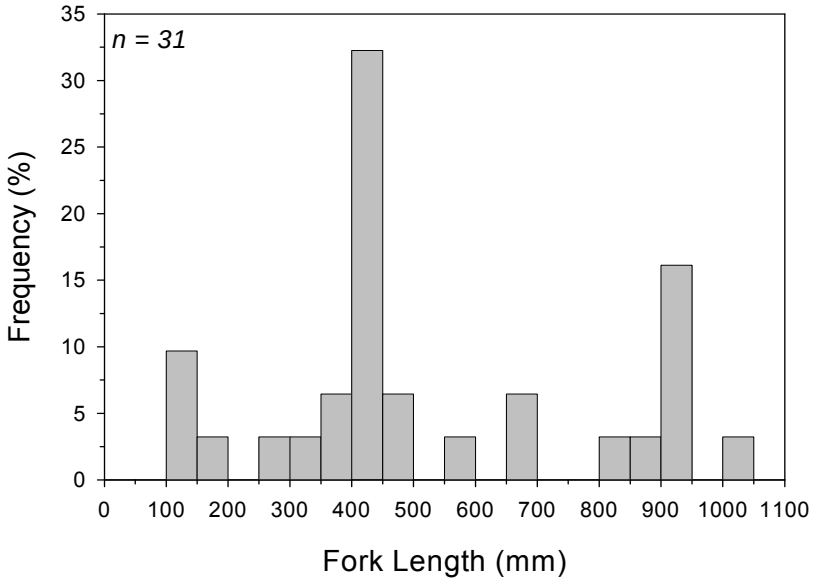



**Figure 4.22 Length-Frequency Distribution of Lake Trout in Windy Lake, 2008**

The length-frequency plot for lake trout in Windy Lake revealed neither a unimodal nor bimodal shape (Figure 4.22). This is likely due to a small sample size (n=31). The length-frequency plot generated by analyses of 1996 and 1997 data reveals a bimodal shape (RL&L/Golder 2002). Authors of this report speculated that this was due to differences in feeding strategy, where the population was divided into piscivorous and benthivorous individuals.

#### *Cisco*

The 227 cisco captured in Windy Lake ranged from 170 to 347 mm in fork length and from 43 to 551 g in wet weight (Appendix C2). The mean length was 291 mm, which was larger than that found in Aimaokatalok or Patch lakes during the 2008 sampling. The mean condition for cisco in Windy Lake was 1.11 (Appendix C2), which is also higher than that found in either Aimaokatalok or Patch lakes. This was higher than the value of 1.05 reported from the 1996-1997 sampling (RL&L/Golder 2002); however, the earlier estimate was only based on five fish.

When weight was regressed against length using a non-linear (power) function, the exponent value was 3.04 (Figure 4.23). This indicates that growth in cisco in Windy Lake is close to isometric, and the fish do not change shape as they grow longer. The corresponding exponent from previous studies was 2.54, but this value was only based on three fish and is thus considerably less reliable (RL&L/Golder 2002).

The length-frequency plot for cisco was unimodal in shape, with the dominant size class in the 300 to 320 mm range. Smaller fish (i.e. YOY and 1+ fish) were under-represented in the catch (Figure 4.24).

### 4.3.3 Wolverine Lake

Fish sampling was conducted in Wolverine Lake on 5 August 2008. The purpose of this sampling was to further characterize the population of least cisco in the lake. Sampling was conducted with a beach seine.

#### 4.3.3.1 Species Composition and Relative Abundance

Least cisco represented 90.3% of the 359 fish captured in Wolverine Lake, with ninespine stickleback representing the remaining 9.8% (Table 4.7). The depauperate fish community in Wolverine Lake is a consequence of its small size and shallow depth, because it is a closed system, with no distinct inflows or outflows. CPUE data for Wolverine Lake are presented in Appendix C6. Beach

seining was a successful method of sampling to assess the small bodied fish community of Wolverine Lake.

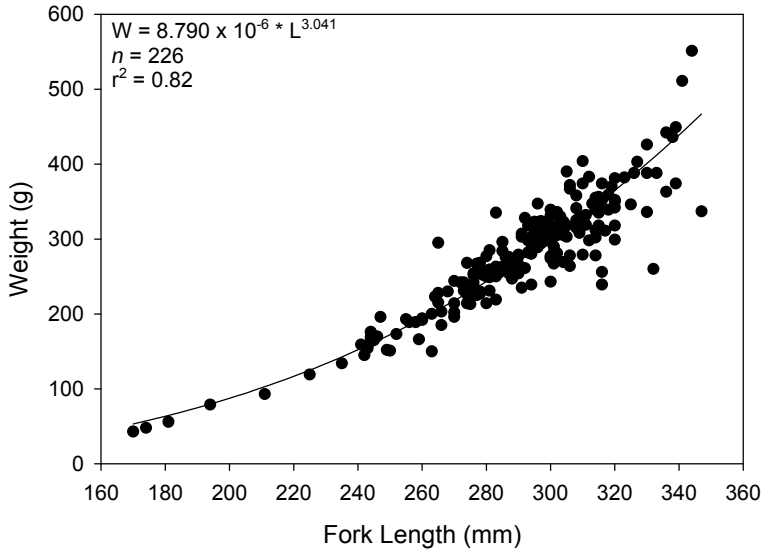



**Figure 4.23 Weight-Length Relationship of Cisco in Windy Lake, 2008**

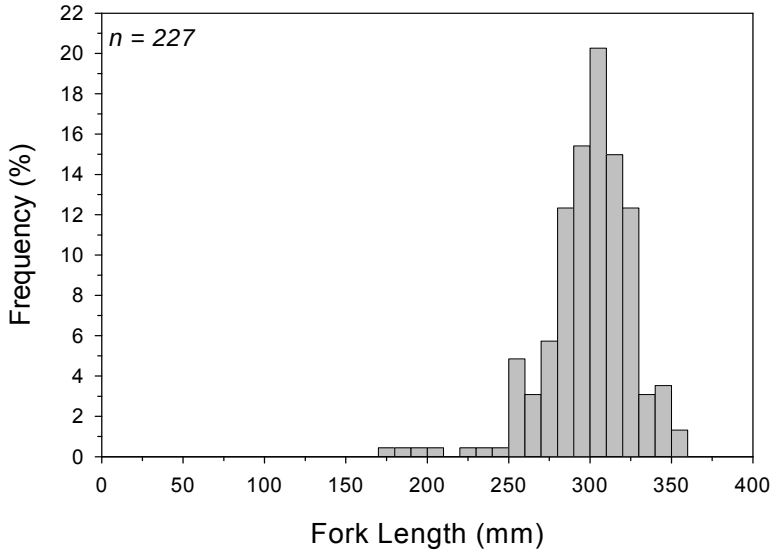



**Figure 4.24 Length-Frequency Distribution of Cisco in Windy Lake, 2008**

**Table 4.7 Fish Species and Number Captured in Wolverine Lake, 2008**

| Capture Method | Least Cisco | Ninespine Stickleback | Total |
|---|---|---|---|
| Beach seining | 324 | 35 | 359 |
| **Total** | **324** | **35** | **359** |
| | **90.3%** | **9.8%** | **100.0%** |

Prepared by: AH
Checked by: HS

## 4.3.3.2 Life History Data

### *Least cisco*

A subset of least cisco captured in Wolverine Lake were measured (n = 37) to reduce handling time and prevent mortality of these stress-sensitive small fish. All 324 fish captured were small, with fork lengths of measured fish ranging from 36 to 66 mm (Appendix C2). The mean fork length was 51 mm, which is considerably smaller than that found for least cisco captured in either Patch or Aimaokatalok lakes (means of 192 mm and 225 mm, respectively). It appears that the population of least cisco in Wolverine Lake is severely stunted. Mean condition factor was also lower in Wolverine Lake (0.68; Appendix C2) than in either Patch or Aimaokatalok lakes (0.77 and 1.02, respectively; Appendix C2). This is most likely due to low prey availability and prey quality in Wolverine Lake relative to the other lakes in the system.

Power regression of weight against length for least cisco revealed an exponent value of 3.17 (Figure 4.25). This indicates that the fish have positive allometric growth and do grow slightly fatter with increased length. This exponent value was less than that found in Aimaokatalok Lake (Figure 4.5; Patch Lake regression is not available). These results should be interpreted with caution, however, because of the small size-range of fish in Wolverine Lake used for the analysis.

The length-frequency plot for least cisco captured in Wolverine Lake showed an even distribution pattern. This was likely due to the narrow range of fork lengths captured (Figure 4.26). The range of fork lengths reported in 2008 is similar to the range previously reported in 2006-2007 (35 to 85 mm) (Golder 2008b). Previous gill netting efforts did not yield any large fish captures in Wolverine Lake (Golder 2008b).

As mentioned above, the population of least cisco in Wolverine Lake seems severely stunted. Dissection of preserved fish to determine maturity and gonad state revealed that these fish are maturing at a very small size.

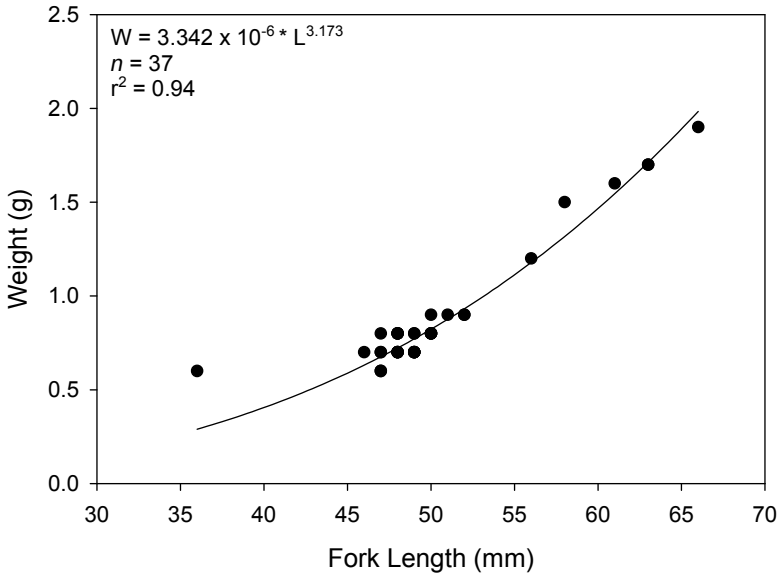



**Figure 4.25 Weight-Length Relationship of Least Cisco in Wolverine Lake, 2008**

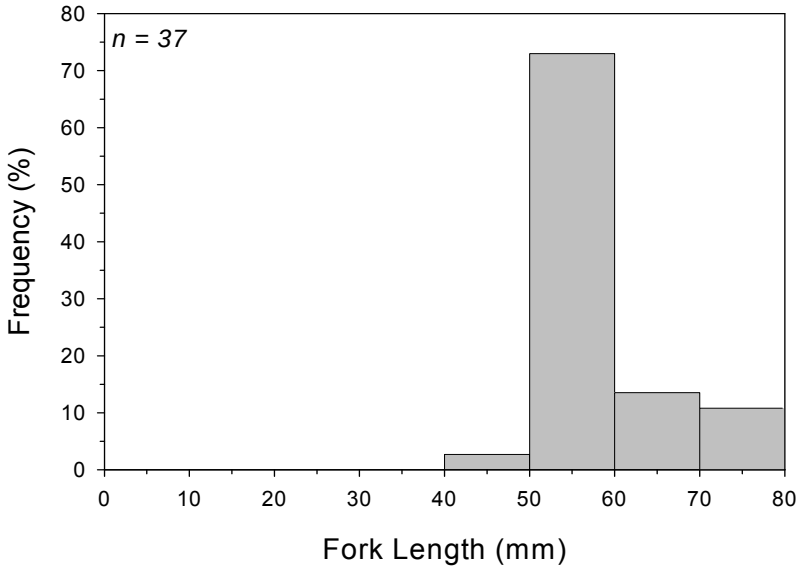



**Figure 4.26 Length-Frequency Distribution of Least Cisco in Wolverine Lake, 2008**

### *Ninespine stickleback*

Of the 35 ninespine stickleback captured, only two were measured because the focus of sampling in Wolverine Lake was to sample the least cisco. The two ninespine stickleback were 42 and 43 mm, respectively (Appendix C2).

## 4.3.4 Madrid Project Area Summary

During the 2008 sampling program, 776 fish representing five species were captured in the Madrid Project Area (Table 4.8). Least cisco dominated the overall catch (42.4%); however, all but five of these fish were captured in two seine net hauls in Wolverine Lake. Cisco contributed 38.3% of the catch, lake trout contributed 6.6%, and ninespine stickleback contributed 5.3% (Table 4.8). Ninespine stickleback were not captured in Patch Lake in 2008 because the sampling program was designed to target lake trout for population assessment; however, this species does inhabit Patch Lake, as indicated by previous sampling programs in the lake.

**Table 4.8 Summary of Fish Captured in the Madrid Project Area, 2008**

| Waterbody | Cisco | Lake Trout | Lake Whitefish | Least Cisco | Ninespine Stickleback | Total |
|---|---|---|---|---|---|---|
| Patch Lake | 70 | 27 | 51 | 5 | | **153** |
| Windy Lake | 227 | 31 | | | 6 | **264** |
| Wolverine Lake | | | | 324 | 35 | **359** |
| **Total** | **297** | **58** | **51** | **329** | **41** | **776** |
| | **38.3%** | **7.5%** | **6.6%** | **42.4%** | **5.3%** | **100.0%** |

Prepared by: AH Checked by: HS

## 4.3.5 Statistics for Fish Growth and Condition

To compare condition and growth of fish among lakes and years, ANCOVA analysis on log-transformed data were used. Unfortunately, comparisons of condition factor (*K)* among lakes and years were not successful. Assumptions of normality were severely violated in all analyses that used condition factor (*K*) as a dependent variable; this was most likely due to uneven sample sizes and, perhaps, differences in the distribution of sizes captured in each lake.

Slopes (b) of log-weight vs. log-length relationships were successfully compared among lakes and years. Comparisons among years were limited to Patch Lake, since this is the only lake sampled in 2008 that had a good multi-year record. Comparisons among lakes included Patch, Windy, and Aimaokatalok – lakes sampled in 2008 with adequate sample sizes.

### 4.3.5.1 Comparisons among lakes

To achieve among-lake comparisons, log-weight was modelled as a function of log-length, lake, and the interaction between the two. If the interaction between the two (i.e., log-length*lake) is significant, this means that relationships between weight and length differ among lakes and that fish in some lakes are fatter or skinnier relative to the other lakes.

#### *Lake trout*

Comparison of log-transformed weight vs. log-transformed length relationships among lakes showed that the mean weight of lake trout did not differ significantly among lakes (ANCOVA, $F = 2.9$, $P = 0.0602$, $df = 2,91$), but that the relationship between weight and length (proxy of growth pattern and condition) did differ significantly among Patch, Windy, and Aimaokatalok lakes (ANCOVA, $F = 4.84$, $P = 0.0100$, $df = 2,93$). All populations had growth patterns that were close to isometric (i.e., slope was near 3; Table 4.9; Figure 4.27). However, this analysis showed that whereas lake trout from Aimaokatalok Lake get slightly skinnier as they grow longer, lake trout from Patch and Windy lakes get slightly fatter as they grow longer. Lake trout from Patch and Windy lakes, therefore, are in slightly better condition than those in Aimaokatalok Lake.

**Table 4.9 Lake-Specific Values of Slope (b) and Sample Sizes for Log-weight vs. Log-length Regressions, 2008**

| Waterbody | Lake Trout | | Lake Whitefish | | Cisco | |
|---|---|---|---|---|---|---|
| | n | Slope (b) | n | Slope (b) | n | Slope (b) |
| Patch Lake | 27 | 3.15 | 47 | 3.53 | 64 | 2.49 |
| Aimaokatalok Lake | 40 | 2.91 | 49 | 3.13 | 11 | 2.7 |
| Windy Lake | 30 | 3.12 | - | - | 226 | 3.04 |

Prepared by: AH
Checked by: HS

#### *Lake whitefish*

Comparison of log-transformed weight vs. log-transformed length slopes between Patch and Aimaokatalok lakes (lake whitefish were not caught in Windy Lake in 2008) showed that the mean weight of lake whitefish (length is also taken into account in this model) differed significantly among lakes (ANCOVA, $F = 6.05$, $P = 0.0158$, $df = 1,92$). At a standardized mass of 400 mm, however, the predicted least-squares mean weight of lake whitefish was similar for both lakes. This indicates that the difference, although significant, was slight and is not likely biologically relevant.

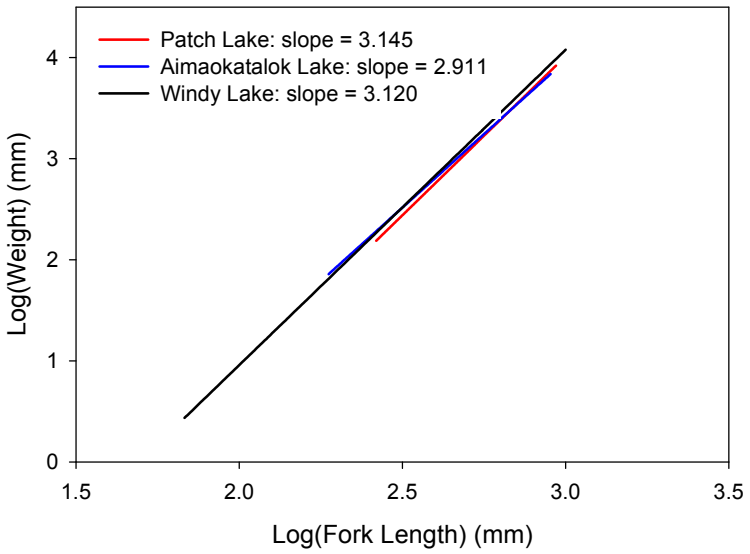



**Figure 4.27 Log-Transformed Weight-Length Regressions of Lake Trout in Aimaokatalok, Patch, and Windy Lakes, 2008**

Growth patterns also differed significantly between Patch and Aimaokatalok lakes (ANCOVA, $F = 5.97$, $P = 0.0165$, $df = 1,92$). Both populations had positive allometric growth; slope (b) values were greater than 3, indicating the fish grow fatter with increased length; however, the slope was larger for Patch Lake than for Aimaokatalok Lake (Table 4.9; Figure 4.28).

### *Cisco*

Comparison of log-transformed weight vs. log-transformed length regressions showed that the mean weight of cisco differed significantly between Aimaokatalok, Windy, and Patch lakes (ANCOVA, $F = 4.54$, $P = 0.0115$, $df = 2,295$). At a standardized length of 200 mm, cisco from Windy Lake had a least-squares mean weight that was heavier than cisco from either Patch or Windy lakes (which were very similar to each other) (Table 4.9; Figure 4.29).

Statistical comparisons among least cisco populations were not possible because the size ranges captured in Aimaokatalok and Patch lakes did not overlap with those captured in Wolverine Lake. It is still obvious, however, that least cisco in Patch and Aimaokatalok lakes are in better condition than the stunted population in Wolverine Lake.

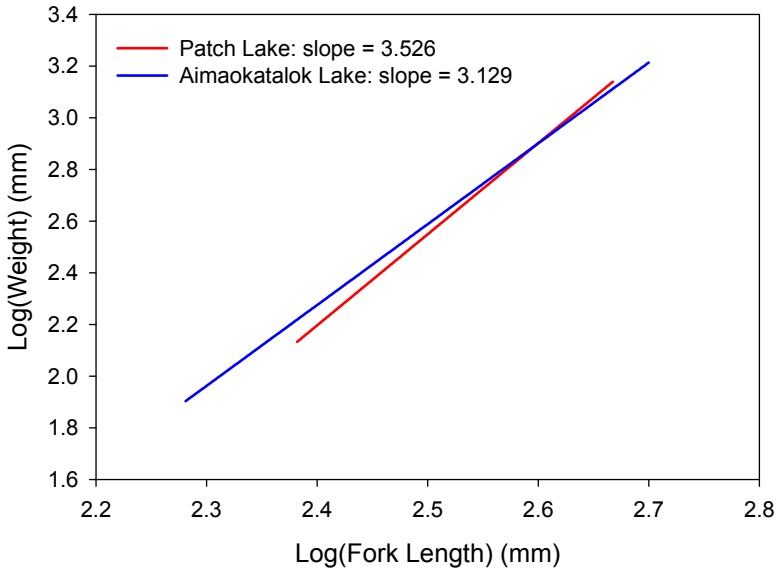



**Figure 4.28 Log-Transformed Weight-Length Regressions of Lake Whitefish in Aimaokatalok and Patch Lakes, 2008**

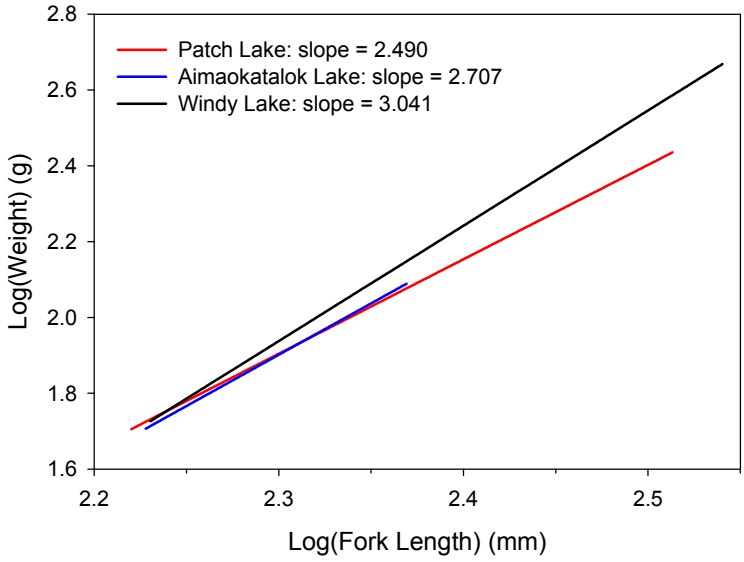



**Figure 4.29 Log-Transformed Weight-Length Regressions of Cisco in Aimaokatalok, Patch, and Windy Lakes, 2008**

### 4.3.5.2 Comparisons among years

To achieve among-year comparisons, log-weight was modelled as a function of log-length, year and the interaction between the two. If the interaction between the two (i.e., log-length*year) is significant, this means that relationships between weight and length differ among years and that fish in some lakes are fatter or skinnier than in other lakes.

#### *Lake trout*

Comparison of log-weight vs. log-length regressions showed that the mean weight of lake trout (with length taken into account) captured in Patch lake differed significantly among years (data from 1997, 2006, 2007, 2008) (ANCOVA, $F = 3.07$, $P = 0.028$, $df = 3,269$). At a standardized length of 600 mm, lake trout caught in 2007 showed heavier least-squares mean weight than in other years and lake trout caught in 1997 showed lighter least-squares mean weight (difference was approximately 15% among these two years). It is not possible to completely explain why this difference occurs, but it is likely a combination of both sampling (i.e. sampling results as well as differences in sample sizes and size ranges of fish captured) and measurement error and real biological variation (e.g., winter of 1996 may have been particularly harsh and caused fish to be in poorer condition the following summer).

Growth patterns differed significantly among years (ANCOVA, $F = 2.96$, $P = 0.032$, $df = 3,269$), with 2008 showing positive allometric growth and all other years showing slightly negative allometric growth (Table 4.10; Figure 4.30). Similar to the discussion above, this likely represents both differences in year-to-year sample sizes and size ranges of fish as well as some real year-to-year variation.

**Table 4.10 Year-Specific Values of Slope (b) and Sample Sizes for Log-Weight vs. Log-Length Regressions in Patch Lake**

| | Lake Trout | | Lake Whitefish | | Cisco | |
|---|---|---|---|---|---|---|
| Year | n | Slope (b) | n | Slope (b) | n | Slope (b) |
| **1997** | **43** | 2.91 | 77 | 3.29 | 30 | 3.03 |
| **2006** | **28** | 2.67 | 37 | 2.91 | 41 | 2.94 |
| **2007** | **179** | 2.85 | 95 | 3.25 | 50 | 3.3 |
| **2008** | **27** | 3.15 | 48 | 3.53 | 64 | 2.49 |

Prepared by: AH
Checked by: HS

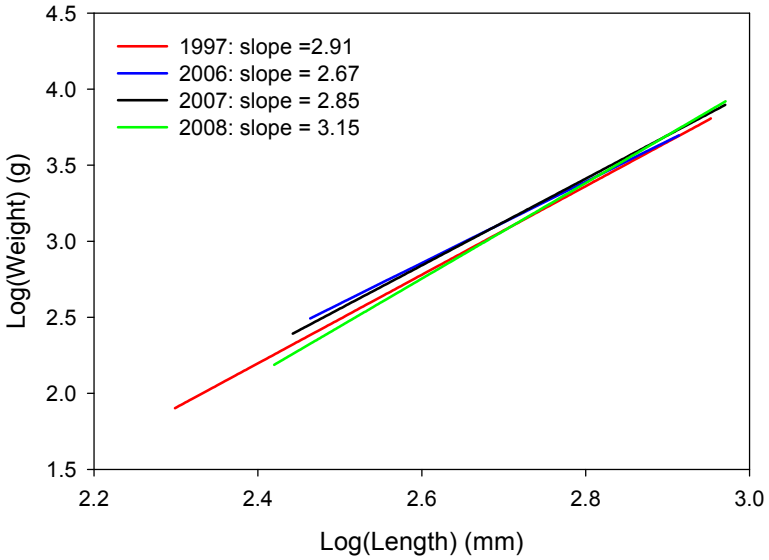



**Figure 4.30 Log-Transformed Weight-Length Regressions of Lake Trout in Patch Lake, 1997, and 2006-2008**

### *Lake whitefish*

Comparison of log-weight vs. log-length regressions showed that the mean weight of lake whitefish differed significantly among years (1997, 2006, 2007, and 2008) in Patch Lake (ANCOVA, $F = 3.32$, $P = 0.021$, $df = 3,248$). At a standardized length of 400 mm, however, least-squares mean fish weight was similar; least-squares means predictions showed that lake whitefish caught in 2007 were heaviest and fish caught in 1997 were lightest, but the differences were not large. The normalized difference between these two years was approximately 10%.

Growth patterns differed significantly among years (ANCOVA, $F = 3.22$, $P = 0.023$, $df = 3,248$). In all years except 2006, positive allometric growth was displayed (Table 4.10; Figure 4.31). Slight negative allometric growth was observed in 2006.

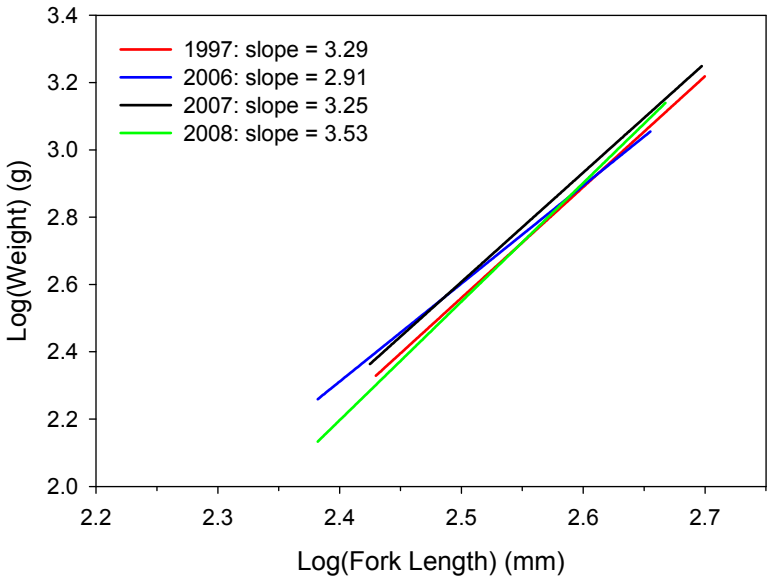



**Figure 4.31 Log-Transformed Weight-Length Regressions of Lake Whitefish in Patch Lake, 1997, and 2006-2008**

### *Cisco*

Comparison of log-weight vs. log-length regressions showed that the mean weight of cisco differed significantly among years (1997, 2006, 2007, and 2008) in Patch Lake (ANCOVA, F = 4.16, P = 0.007, df = 3,177). At a standardized length of 200 mm, least-squares means predictions showed that cisco caught in Patch Lake in 2008 were heaviest and those caught in 2007 were lightest. The normalized difference between these two years was approximately 20% but represents only 14 g (min = 70, max = 84).

Growth patterns differed significantly among years (ANCOVA, F = 4.5, P = 0.005, df = 3,177). Growth for the fish sampled was positively allometric ('b'>3) in 1997 and 2007 and negatively allometric in 2006 and 2008 (Table 4.10; Figure 4.32).

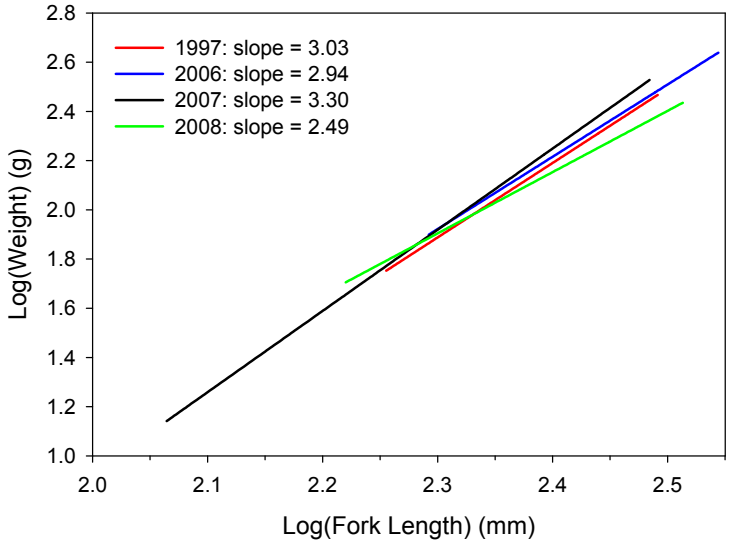



**Figure 4.32 Log-Transformed Weight-Length Regressions of Cisco in Patch Lake, 1997 and 2006-2008**

### *Statistics Summary*

The main purpose of the statistical exercise was to demonstrate that, within a species, significant variation in fish growth and condition exists among years and among lakes. Some of this variation is likely due to measurement error and sampling artifacts, but some of it likely represents real biological variation. This variation must be taken into consideration during any post-development fisheries assessments.

# 5 FISH HABITAT

The 2006 and 2007 field programs for the Boston and Madrid Project Areas were designed to extend and update baseline data for future infrastructure development and environmental assessment. The 2006 fish habitat surveys were based on measurements collected from boat and shore operations, which provided a general description of substrate type composition, aquatic vegetation presence, and the near-shore riparian environment. The 2006 surveys were conducted for Reference, Fickle Duck, Stickleback, Ogama, Patch, P.O., P.O. Inflow, and Wolverine lakes. The 2007 program included ground truthing of the 2006 assessments, as well as aerial habitat surveys for the South arm of Aimaokatalok, Stickleback, Fickleduck, Ogama, Patch, P.O., and Pelvic lakes. The 2008 fish habitat focus was on mapping the substrates of Patch Lake.

## 5.1 METHODS

### 5.1.1 Shoreline Substrate and Riparian Habitat

Assessments of substrate type composition was performed by visually identifying and spatially delineating regions of lake-bottom into individual habitat units, which were characterized by general uniformity of substrate type composition. Substrate types within each habitat unit were based on a visual estimate regarding the relative abundance of each of the recognized particle grain size ranges defined by the Wentworth grade scale (Cummins 1962). Although bedrock substrate cannot be defined by particle grains size, it was included as a type class for this assessment due to its prevalence within the study area, as well as its qualitative relevance with respect to fish habitat. Substrate types were assessed by the following classifications:

- Bedrock (Bd);
- Fractured bedrock (Fb);
- Boulder (Bo; >256 mm);
- Cobble (Co; 64-256 mm)
- Gravel (Gr; 2-64mm);
- Sand (Sa; 62.5 µm-2mm); and
- Silt (Si; < 62.5 µm)

Visual classification of substrate type composition was restricted by water clarity to a maximum depth of approximately 2 m during this survey. However, the

areas surveyed were within the littoral zone, and are generally characterized as high productivity habitats, which are available only during the open water season as ice thickness can be up to 2 m thick over-winter.

Bedrock generally does not provide high quality habitat for fish because it lacks suitable coarseness for spawning and does not provide cover to rearing fish or prey. Fractured bedrock may provide cover for small lake trout, resulting in feeding habitat for larger lake trout; however, the overall habitat quality is low. Boulder, cobble, and gravel substrates located within the littoral zone provide high quality habitat for rearing and feeding during open water periods. These coarse substrate size-classes are also important within the spawning grounds, below ice cover. Silt and sand substrate types generally provide good feeding habitat for coregonids and lake trout.

The locations of aquatic vegetation, flooded or overhanging riparian vegetation, and slumping riparian terrain along the shoreline were assessed during the fish habitat surveys. These features may provide areas of protective cover from predation or environments supporting the production of food items (i.e., invertebrates and small bodied fish) for consumption by higher trophic-level fish. These vegetation zones are representative only and do not depict exact measured regions.

### 5.1.2 Bathymetry and Physical Properties

Bathymetry data for Patch Lake were collected using an ODOM® Hydrotrac Survey Echo Sounder with a 200 kHz transducer and a Trimple differential GPS. Transects were spaced at a minimum of 50 m (Golder 2006b).

Bathymetry data for Ogama, P.O., P.O. Connector, and Wolverine lakes were collected using a Biosonics DT-X echosounder with a 200-kHz transducer and a Garmin GPSMap 76CSx GPS Unit. The bathymetry data were analyzed using the Visual Bottom Typing Seabed Classifier 2 (VBT2) software (version 1.0.0.1 beta). Transects spacing was variable in each lake, based on basin shape.

Bathymetry data for Stickleback Lake were collected by Rescan Environmental in 1993 using a Raytheon echosounding chart recorder to record depths and a topographic map for positioning (Rescan 1993). These data were not accurately georeferenced, so the bathymetric data for this lake must be interpreted with caution.

# 5.2 RESULTS

## 5.2.1 Boston Project Area

### 5.2.1.1 Fickle Duck Lake

Fickle Duck Lake is located near the south-east end of Aimaokatalok Lake. It is a small lake (55 ha), with a maximum depth of approximately 3 m (Table 5.1). Bathymetric contour information was not available for Fickle Duck Lake; therefore, the lake volume could not be calculated. Inflow is provided by several small streams entering the lake along the east and south shorelines, and the outflow runs north for approximately 400 m before emptying into a narrow arm of Aimaokatalok Lake. Fickle Duck Lake is situated approximately 300 m east of Stickleback Lake (Figure 5.1).

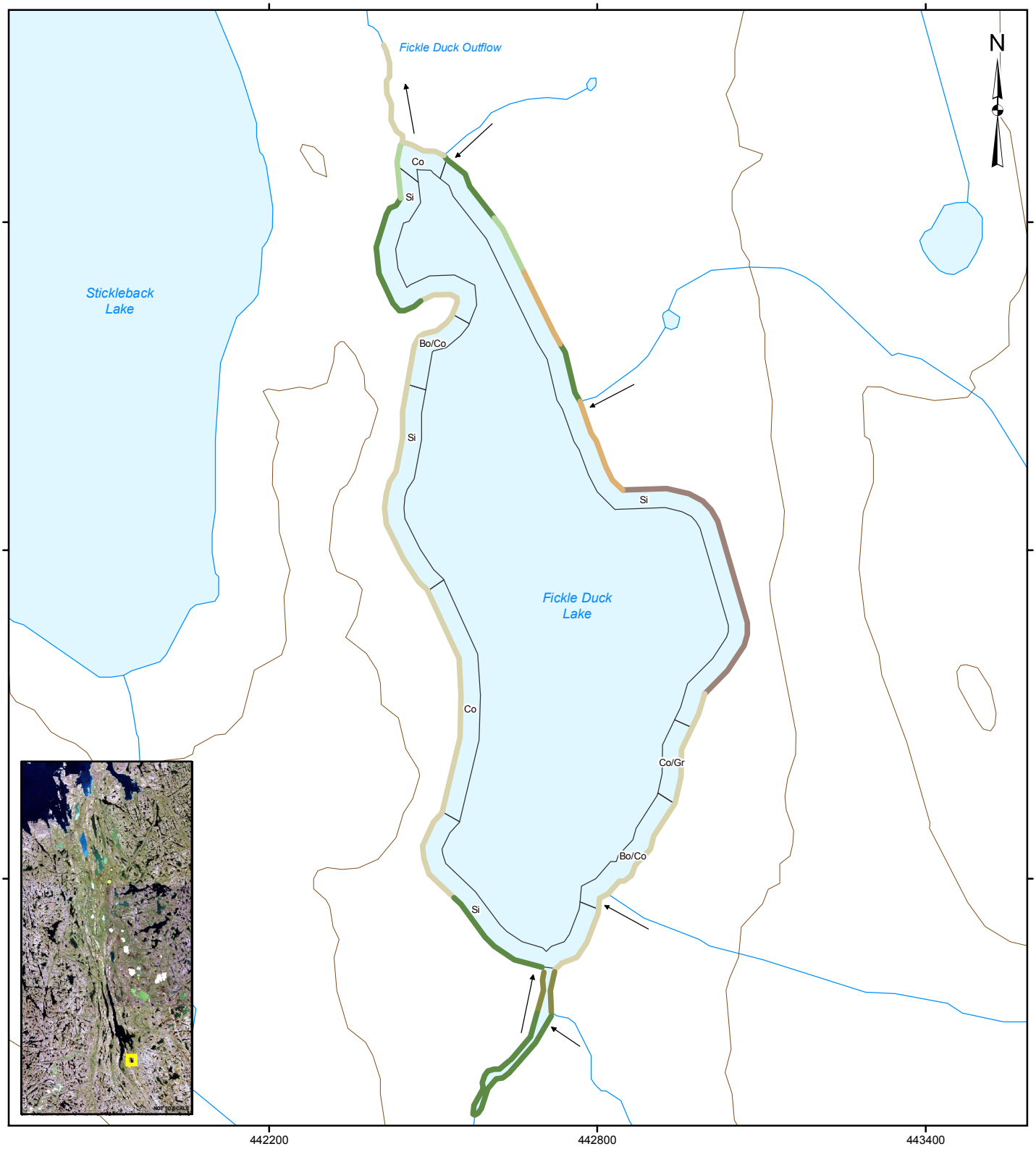
**Table 5.1 Physical Properties of Fickle Duck Lake**

| | |
|---|---|
| **Area** | 55 ha |
| **Maximum depth*** | > 3 m |
| **Length (fetch)** | 1500 m |
| **Maximum width** | 600 m |
| **Shoreline length** | 3852 m |

*maximum depth is reported at the water quality station; however, bathymetric surveys have not been done to confirm the deepest point in the lake.

The shoreline and littoral zone substrate in Fickle Duck Lake is predominantly silt (Si); however, cobble (Co), and boulder/cobble (Bo/Co) substrates were also present (Figure 5.1). The under-ice water depth in Fickle Duck Lake is shallow, and much of the lake is expected to freeze to the substrate. The cobble and boulder habitat may provide good rearing and feeding habitat for fish during the openwater season, but the shallow depth would preclude fall spawners (lake trout) from using this substrate as spawning habitat. The offshore extent of the habitat units depicted in Figure 5.1 are for display purposes only, and do not represent the true extent of the habitat units.

Two small areas of emergent aquatic vegetation were noted along the north end of the lake near the outflow (Photo 5.1). Additional cover for fish was provided by overhanging shrubs on the east and west shorelines (Figure 5.1; Photo 5.2) and small areas of flooded shrubs found near the inflow and outflow. The riparian area around the lake was vegetated with shrubs and grasses (Figure 5.1).




**LEGEND**

- EMERGENT MACROPHYTE
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN GRASS/FORB
- SLUMPING SHORELINE
- RIPARIAN SHRUB
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Si | SILT |
| Co | COBBLE | | |

300 0 300

SCALE 1:10000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

# FICKLE DUCK LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, BOSTON PROJECT AREA

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 2 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 15 Dec. 2008 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.1**

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**Photo 5.1 Vegetated Area at Fickle Duck Outflow, 2006**

**Photo 5.2 Overhanging Shrubs on the South-West Shore of Fickle Duck Lake, 2006**

### 5.2.1.2 Reference Lake

Reference Lake is a relatively long but narrow waterbody, located approximately 3 km west of the southern arm of Aimaokatalok Lake (Table 5.2). It is a shallow lake, with a maximum depth of approximately 4 m, and a surface area of 62 ha. Bathymetric contour information has not been collected for Reference Lake; therefore, the lake volume could not be calculated. Inflow to Reference Lake is provided by a small drainage basin south of the lake. The outflow of Refence Lake flows north where it combines with another small stream prior to discharging into an unnamed waterbody, which is a part of the Koignuk River proper.

**Table 5.2 Physical Properties of Reference Lake**

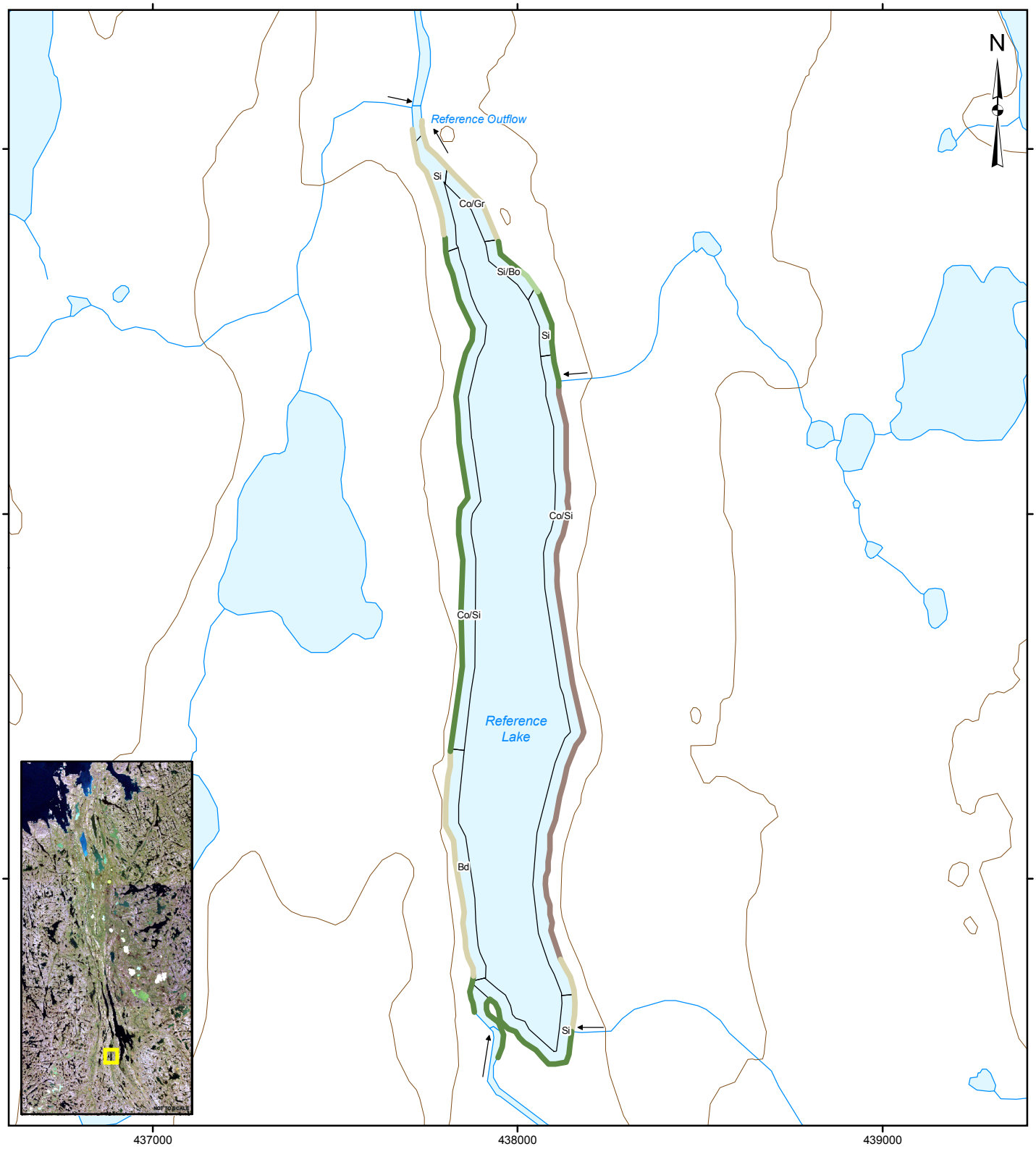
| | |
|---|---|
| **Area** | 62 ha |
| **Maximum depth*** | > 4 m |
| **Length (fetch)** | 2450 m |
| **Maximum width** | 345 m |
| **Shoreline length** | 5981 m |

Prepared by: SJ
Checked by: AH

*maximum depth is reported at the water quality station; however, bathymetric surveys have not been done to confirm the deepest point in the lake.

The majority of the Reference lake shoreline and nearshore zone substrate is cobble/silt (Co/Si) or silt (Si); however, two small habitat units located at the north end of the lake had subdominant boulder or gravel substrate types (i.e., [Si/Bo] and [Co/Gr]; Figure 5.2; Photo 5.3). The cobble habitat may provide suitable rearing and feeding habitat for salmonid species and the silt habitat may provide feeding habitat for coregonids. The southern portion of the west shore was composed of bedrock (Bd) outcrops, which are considered low quality fish habitat. The offshore extent of the habitat units depicted in Figure 5.2 are for visual representation only and do not represent the true extent of the habitat units.

Cover for fish was provided by shrubs overhanging the water along the majority of the east shoreline (Figure 5.2). Shrubs, which were flooded due to seasonal high water levels, were abundant along the west shore resulting in cover for shallow littoral zone small fish during the open-water season. Aquatic vegetation was noted in a small area near the north end of the lake. The riparian area around the lake was vegetated with shrubs and grasses (Photo 5.4).




**LEGEND**

- EMERGENT MACROPHYTES
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN SHRUBS
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Si | SILT |
| Bd | COBBLE | | |

500 0 500

SCALE 1:15000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

# REFERENCE LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, BOSTON PROJECT AREA

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.2**

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**Photo 5.3 Cobble Substrate at the South End of Reference Lake, 2006**

**Photo 5.4 Flooded Vegetation at the North End of Reference Lake, 2006**

### 5.2.1.3 Stickleback Lake

Stickleback Lake is a shallow lake with maximum depth of approximately 3.5 m, and a surface area of 99 ha (Table 5.3). Approximately half of the total lake area is between 2 to 3 m deep, and about one-third of the lake is less than 2 m deep (Figure 5.3). Based on bathymetric data collected in 1993 (Rescan 1993), Stickleback Lake has a volume of approximately 1.99 x$10^6$ $m^3$ (Table 5.3; Figure 5.4). The lake is located approximately 200 m south of Aimaokatalok Lake, and 300 m west of Fickle Duck Lake. The drainage basin around the lake is small, and tributaries flowing into the lake consisted of three tiny streams, which provide minimal inflow to the lake (Figure 5.3). The outflow of Stickleback Lake is located at the north-east end of Stickleback Lake, and empties directly into a narrow arm of Aimaokatalok Lake.

**Table 5.3 Physical Properties of Stickleback Lake**

| | |
|---|---|
| **Area** | 99 ha |
| **Volume** | 1.99 x $10^6$ $m^3$ |
| **Maximum depth** | 3.5 m |
| **Mean depth** | 1.2 m |
| **Length (fetch)** | 1670 m |
| **Maximum width** | 1050 m |
| **Shoreline length** | 4819 m |

Prepared by: SJ Checked by: AH

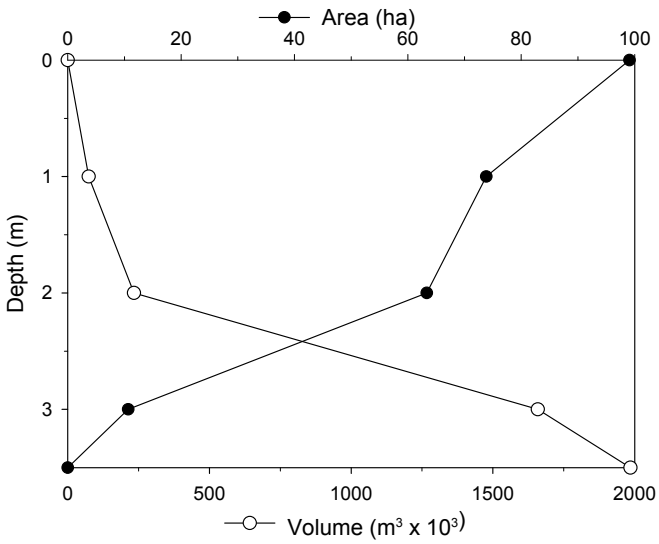
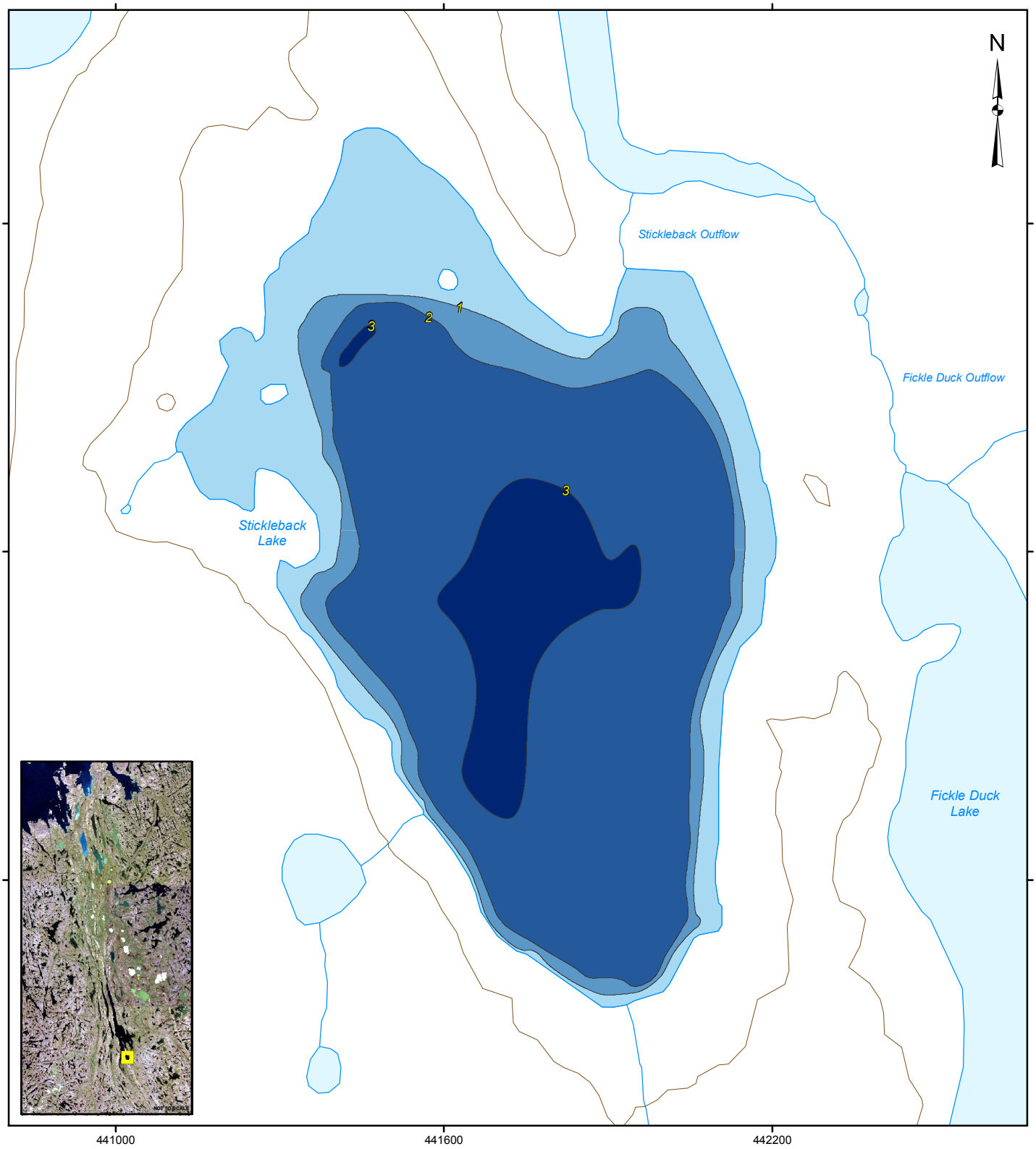



**Figure 5.3 Depth – Area and Volume Hypsograph of Stickleback Lake**




**LEGEND**

- CONTOUR (20 m INTERVAL)
- ISOBATH
- WATERCOURSE
- WATERBODY

**WATER DEPTH (m)**

0 1 2 3 4

300 0 300

SCALE 1:10000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Rescan Environmental, 1993.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**STICKLEBACK LAKE BATHYMETRY**
**BOSTON PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.4**

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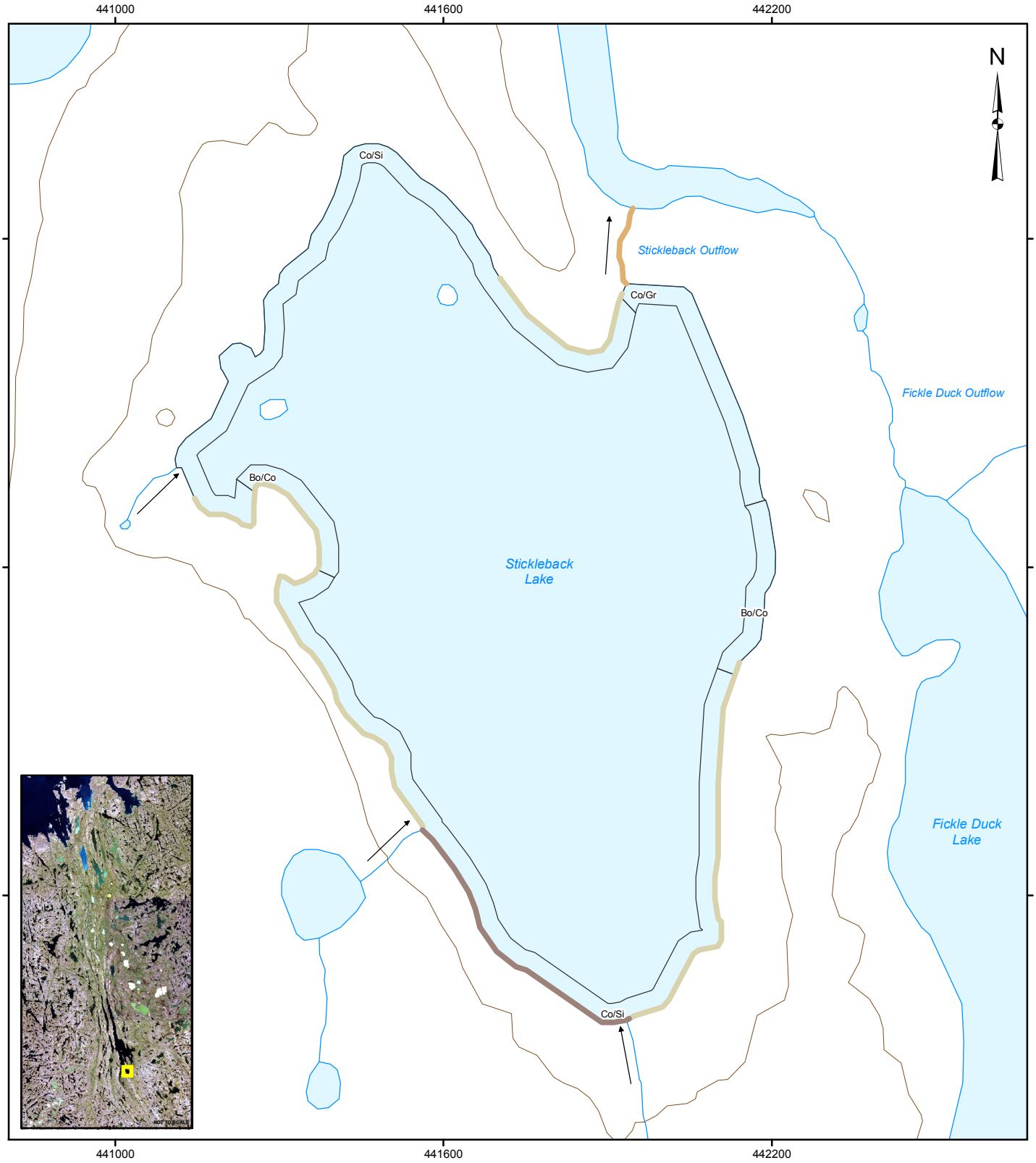
The majority of the substrate found within the nearshore zone of Stickleback Lake was cobble/silt (Co/Si) and boulder/cobble (Bo/Co); however, an area of cobble/gravel (Co/Gr) extends along the north-east shoreline, near the outflow (Figure 5.5). The offshore extent of the habitat units depicted in Figure 5.5 are for display purposes, and do not represent the true extent of the habitat units.

Cover for fish is provided by overhanging shrubs extending along the south-west shoreline for approximately 500 m (Photo 5.5). The remainder of the riparian area bordering the lake is vegetated with small shrubs that do not overhang the water surface (Photo 5.6).

Due to the shallow maximum depth of Stickleback Lake (i.e. about 3.5 m), the available habitat in the lake does not support salmonid species, such as lake trout or coregonids. The only species of fish present in the lake appears to be ninespine stickleback, which can tolerate low dissolved oxygen levels and shallow under-ice depths.

**Photo 5.5 Overhanging Shrubs on the South-West Shore of Stickleback Lake, 2006**




**LEGEND**

- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN GRASS/FORB
- RIPARIAN SHRUB
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Si | SILT |
| Co | COBBLE | | |

300 0 300

SCALE 1:10000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

# STICKLEBACK LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, BOSTON PROJECT AREA

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.5**

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**Photo 5.6 Vegetated Shoreline of Stickleback Lake, 2006**

## 5.2.2 Madrid Project Area

### 5.2.2.1 Ogama Lake

Ogama Lake is long and narrow, with a surface area of 158 ha, and a maximum depth of 5.9 m recorded in 2006 (Table 5.4). Approximately half of the total lake area is between 2 to 3 m deep, about one-quarter is between 3 and 4 m deep, and the remainder (about one quarter) is less than 2 m deep (Figure 5.6). The lake volume was approximately 3.85 $x10^6$ $m^3$ based on the 2006 bathymetric survey (Figure 5.7). Ogama Lake is situated within a large drainage system consisting of five consecutive lakes, within the drainage from Patch Lake to Doris Lake. However, Ogama Lake inflow is directly sourced from P.O. Connector Lake, which enters Ogama Lake from the south. Other sources of flow into the lake are negligible, and are limited to run-off from the adjacent riparian area. Ogama Outflow is located at the north end of the lake and discharges directly into Doris Lake.

**Table 5.4 Physical Properties of Ogama Lake**

| | |
|---|---|
| **Area** | 158 ha |
| **Volume** | 3.85 x $10^6$ $m^3$ |
| **Maximum depth** | 5.9 m |
| **Mean depth** | 2.4 m |
| **Length (fetch)** | 3975 m |
| **Maximum width** | 550 m |
| **Shoreline length** | 9163.5 m |

Prepared by: SJ Checked by: AH

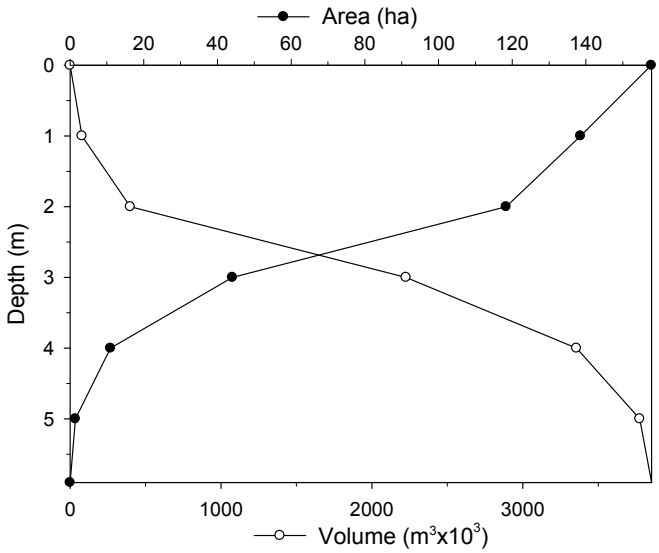



**Figure 5.6 Depth – Area and Volume Hypsograph of Ogama Lake**

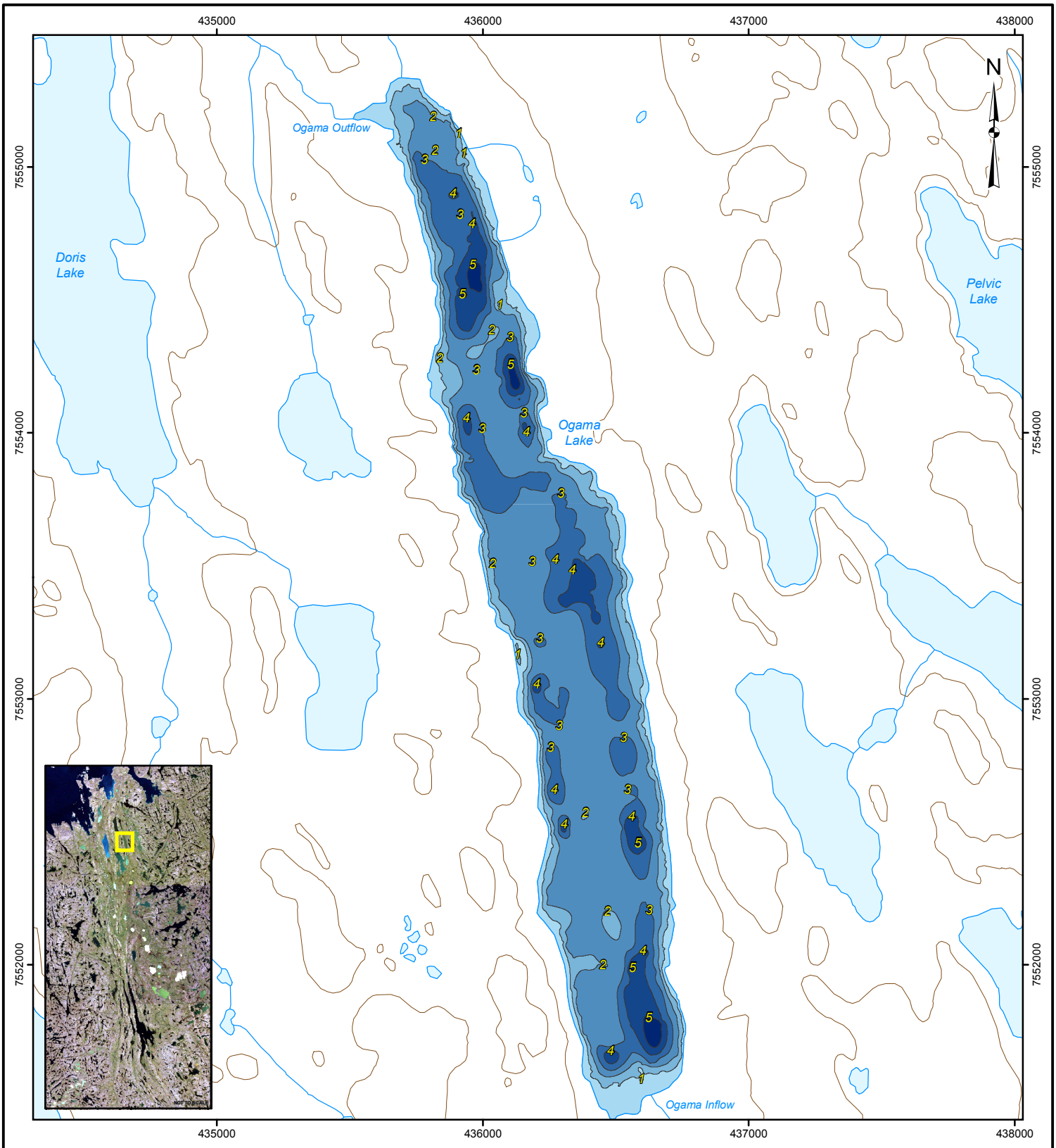
Substrate type composition identified within the littoral zone of Ogama Lake exhibited a diversity of habitat classes, which included dominant/subdominant combinations of silt, sand, cobble, and boulder; however, homogeneous areas of bedrock (Bd), silt (Si), and sand (Sa) were also present (Figure 5.8). Several areas of coarse substrate may provide suitable rearing and feeding habitat for salmonids, and feeding habitat for coregonids is also present in many areas. The offshore extent of the habitat units depicted on Figure 5.8 are for display purposes only, and do not represent the true extent of the habitat units. The majority of the lake basin is silt or soft substrate below 2 m depth (unpublished file data).

Emergent macrophytes were only observed at the north end of the lake, near the outflow. The majority of the riparian vegetation along the shoreline was shrubs; however, no substantial areas of overhanging vegetation providing fish

cover were observed. Sections of slumping shoreline were noted along the east and west sides of the lake (Figure 5.8).

**Photo 5.7 Bedrock Outcrop on West Shore of Ogama Lake, 2006**

**Photo 5.8 Sand Substrate on South Shore of Ogama Lake, 2006**




**LEGEND**

- CONTOUR (20 m INTERVAL)
- ISOBATH
- WATERCOURSE
- WATERBODY

**WATER DEPTH (m)**

0 1 2 3 4 5 6

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**OGAMA LAKE BATHYMETRY**
**MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 6 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.7**

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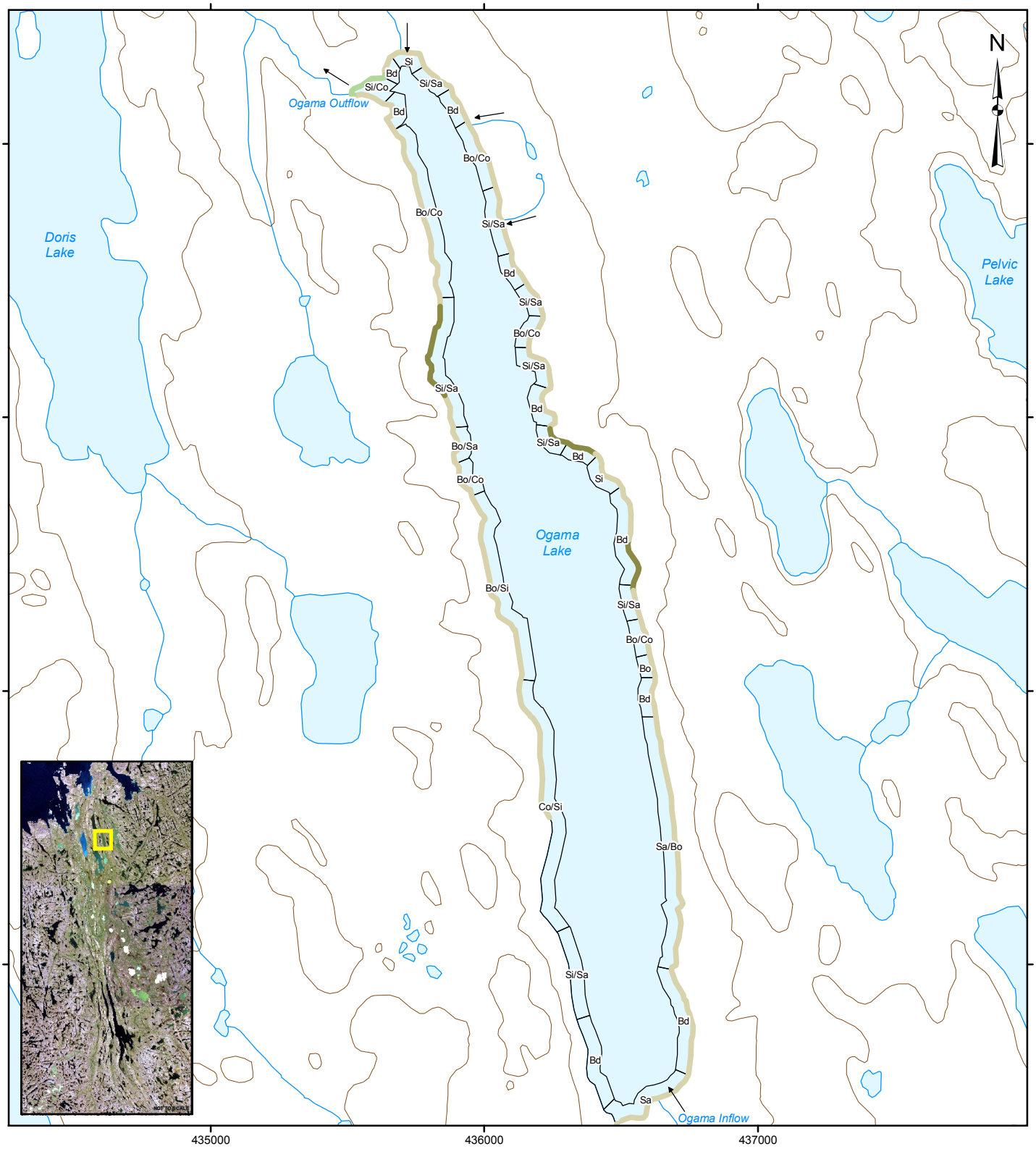


**LEGEND**

| | | | | | |
|---|---|---|---|---|---|
| EMERGENT MACROPHYTE | | WATERBODY | | | |
| RIPARIAN SHRUB | | NEARSHORE SUBSTRATE ZONE | | | |
| SLUMPING SHORELINE | Bd | BEDROCK | Gr | GRAVEL | |
| CONTOUR (20 m INTERVAL) | Bo | BOULDER | Sa | SAND | |
| WATERCOURSE | Co | COBBLE | Si | SILT | |

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

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TITLE

**OGAMA LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
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| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.8**

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### 5.2.2.2 Patch Lake

Patch Lake is a large waterbody relative to most of the other waterbodies in the Doris and Madrid Project Areas; the lake spans a distance of approximately 6.5 km between its north and south shores, and has a maximum width of approximately 1.2 km (Table 5.5). The surface area of Patch Lake is approximately 576 ha, and there is about 23 km of shoreline. The maximum depth recorded in Patch Lake was 15.1 m during a detailed bathymetric survey conducted by Golder in 2006 (Table 5.5). Approximately half of the total lake area is between 2 and 4 m deep; about 100 ha of the lake is greater than 6 m deep (Figure 5.9). Based on the 2006 bathymetry data, Patch Lake has an approximate volume of 23.6 x $10^6$ $m^3$ (Table 5.5; Figure 5.10).

**Table 5.5 Physical Properties of Patch Lake**

| | |
|---|---|
| **Area** | 576 ha |
| **Volume** | 23.6 x $10^6$ $m^3$ |
| **Maximum depth** | 15.1 m |
| **Mean depth** | 4.1 m |
| **Length (fetch)** | 6470 m |
| **Maximum width** | 1175 m |
| **Shoreline length** | 23,013 m |

Prepared by: SJ Checked by: AH

The two small lakes (Wolverine and unnamed) have outflows draining directly into Patch Lake; however, due to the small size of each collection basin, flow has only been observed during spring snow melt, or during heavy rain events. Patch Lake outflow is located on the east shore, where it empties directly into P.O. Lake (Figure 5.10).

Assessment of the substrate composition within the littoral zone of Patch Lake suggests a high degree of habitat diversity was present. Nineteen distinct permutations of substrate type were identified in the littoral zone, although the relative abundance of these types varied greatly (Figures 5.11 and 5.12). The habitat units depicted in Figures 5.11 and 5.12 are for display purposes only, and do not represent the true extent of the habitat units.

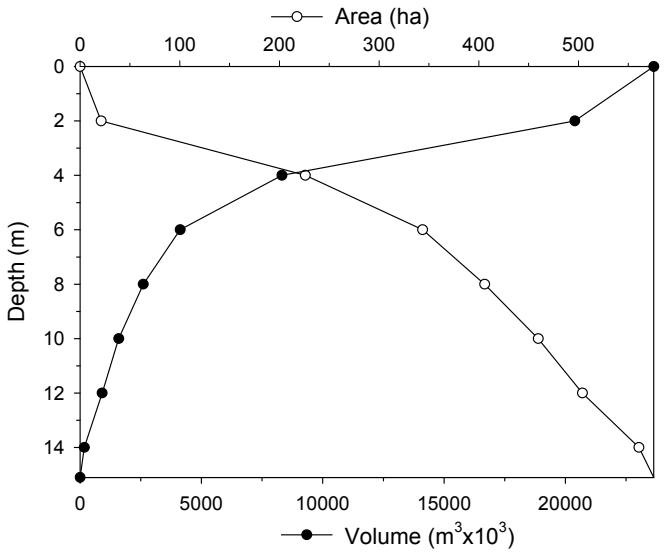
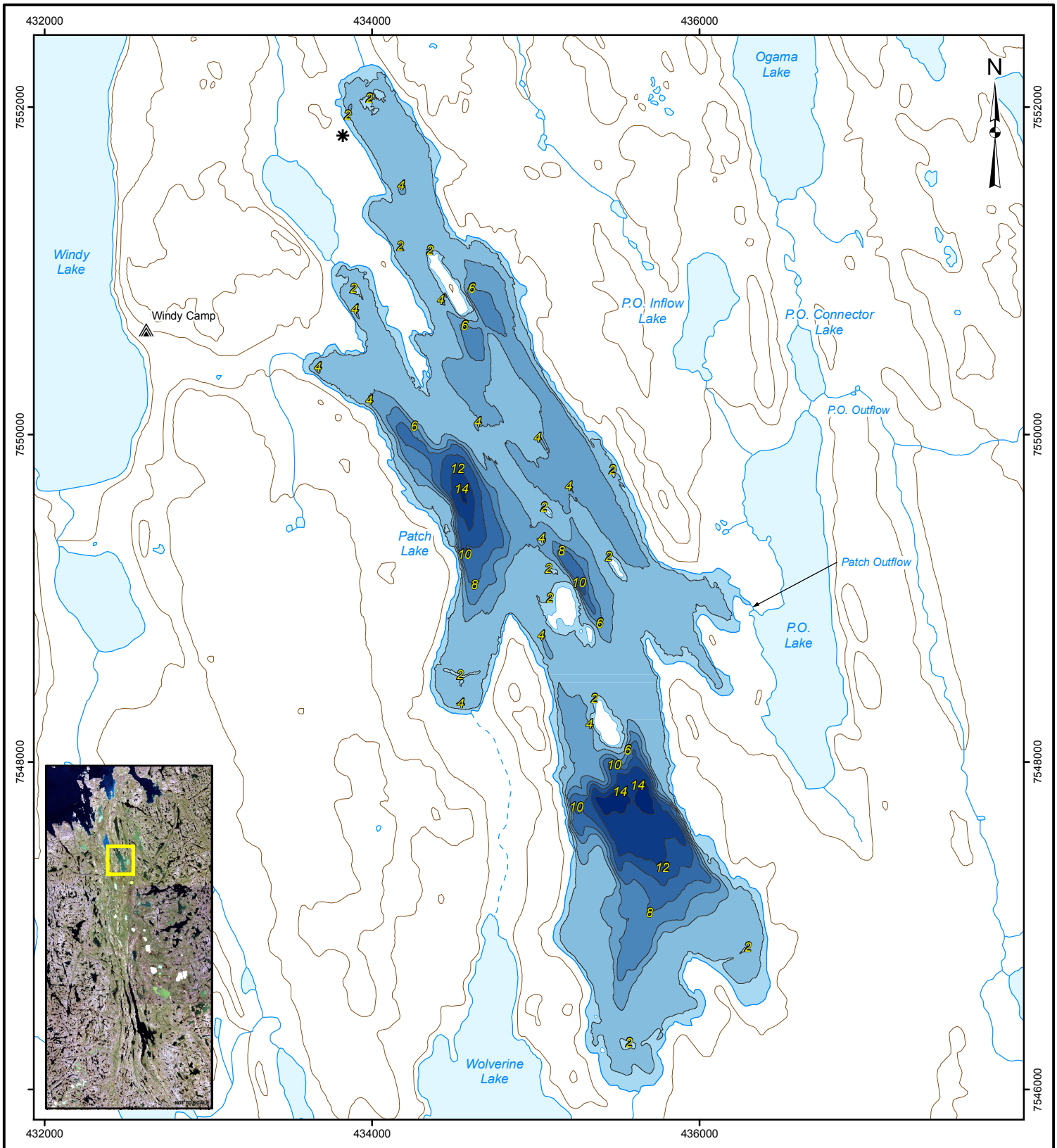



**Figure 5.9 Depth – Area and Volume Hypsograph of Patch Lake**

Bedrock (Bd) had the highest relative abundance among all the substrate types identified (Figures 5.12 and 5.13; Photo 5.9). Bedrock generally does not provide high quality habitat for fish because it lacks suitable coarseness for spawning and does not provide cover for rearing fish or prey. Substrate type compositions, which include fractured bedrock (Fb) as either the dominant or subdominant class, accounted for a smaller portion of the total surveyed area. Fractured bedrock may provide cover for small lake trout, resulting in feeding habitat for larger lake trout; however, the overall habitat quality is low.

Boulder/cobble (Bo/Co) and gravel/sand (Gr/Sa) substrate composition were also plentiful (Figures 5.11 and 5.12; Photo 5.10). Boulder, cobble, and gravel substrates located within the littoral zone provide high quality habitat for rearing and feeding during open water periods. These coarse substrate size-classes are also important within the spawning grounds; however, the fish species inhabiting Patch Lake are fall spawners (except ninespine stickleback) and therefore eggs of these species must be laid below the maximum depth of ice cover, which often reaches 2 m. At depths greater than 2 m, the substrate is dominated by silt or soft substrates (unpublished file data).

Silt (Si) and silt/sand (Si/Sa) substrate types were reported for approximately one quarter of the surveyed nearshore zone (Figures 5.11 and 5.12). This substrate generally provides good feeding habitat for coregonids and lake trout.




**LEGEND**

- CAMP
- MAJOR DRILLING SHOP
- CONTOUR (20 m INTERVAL)
- ISOBATH
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

Depth_m

0 2 4 6 8 10 12 14 15

1000 0 1000

SCALE 1:32500 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

**PATCH LAKE BATHYMETRY**
**MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 4 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
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| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.10**

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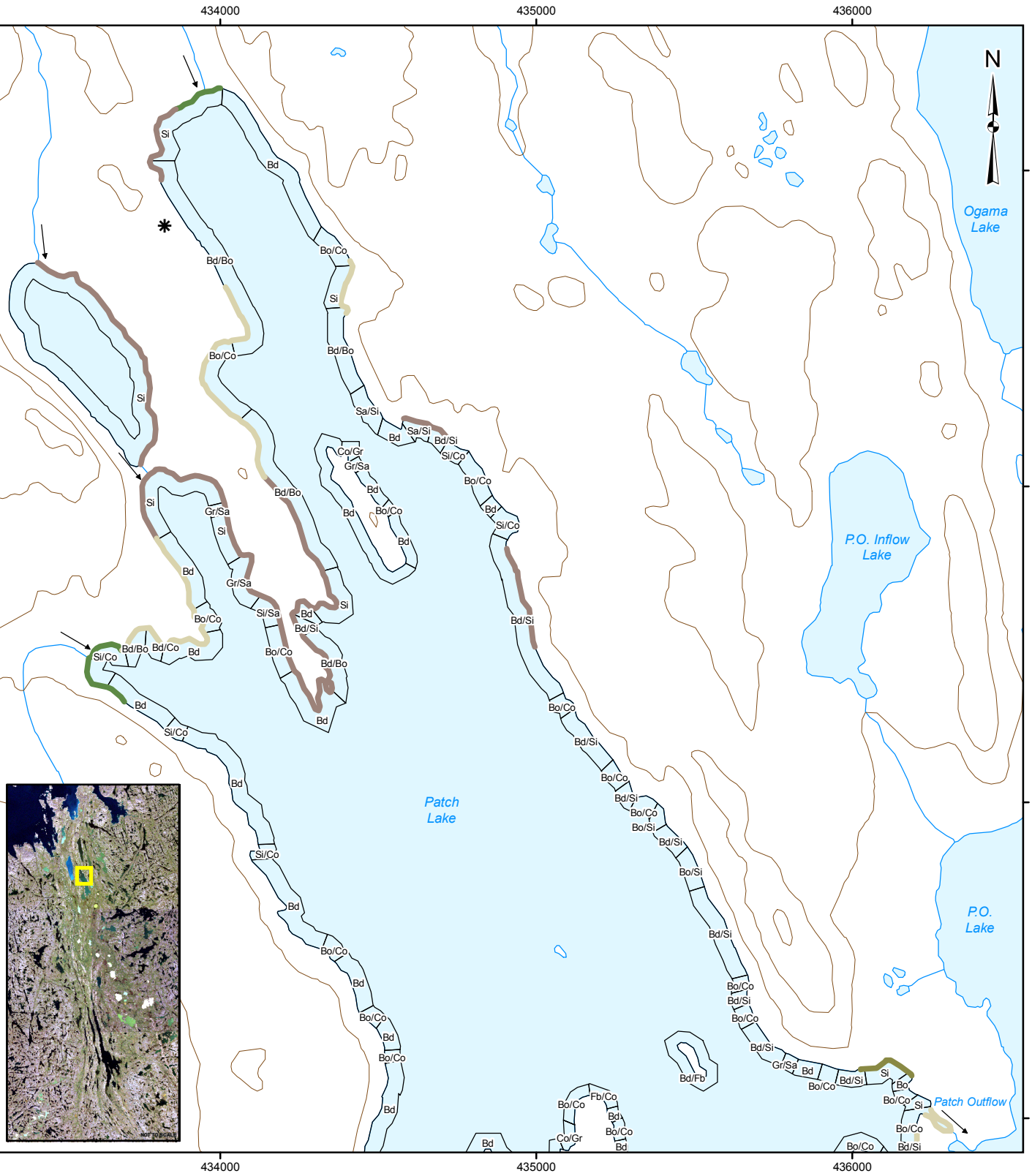


## LEGEND

- MAJOR DRILLING SHOP
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN SHRUB
- SLUMPING SHORELINE
- CONTOUR (10 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Sa | SAND |
| Co | COBBLE | Si | SILT |
| Fb | FRACTURED BEDROCK | | |

500 0 500

SCALE 1:17500 METRES

## REFERENCE

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery captured in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2008.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

# PATCH LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT (NORTH END), MADRID PROJECT AREA

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | FIGURE: 5.11 | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

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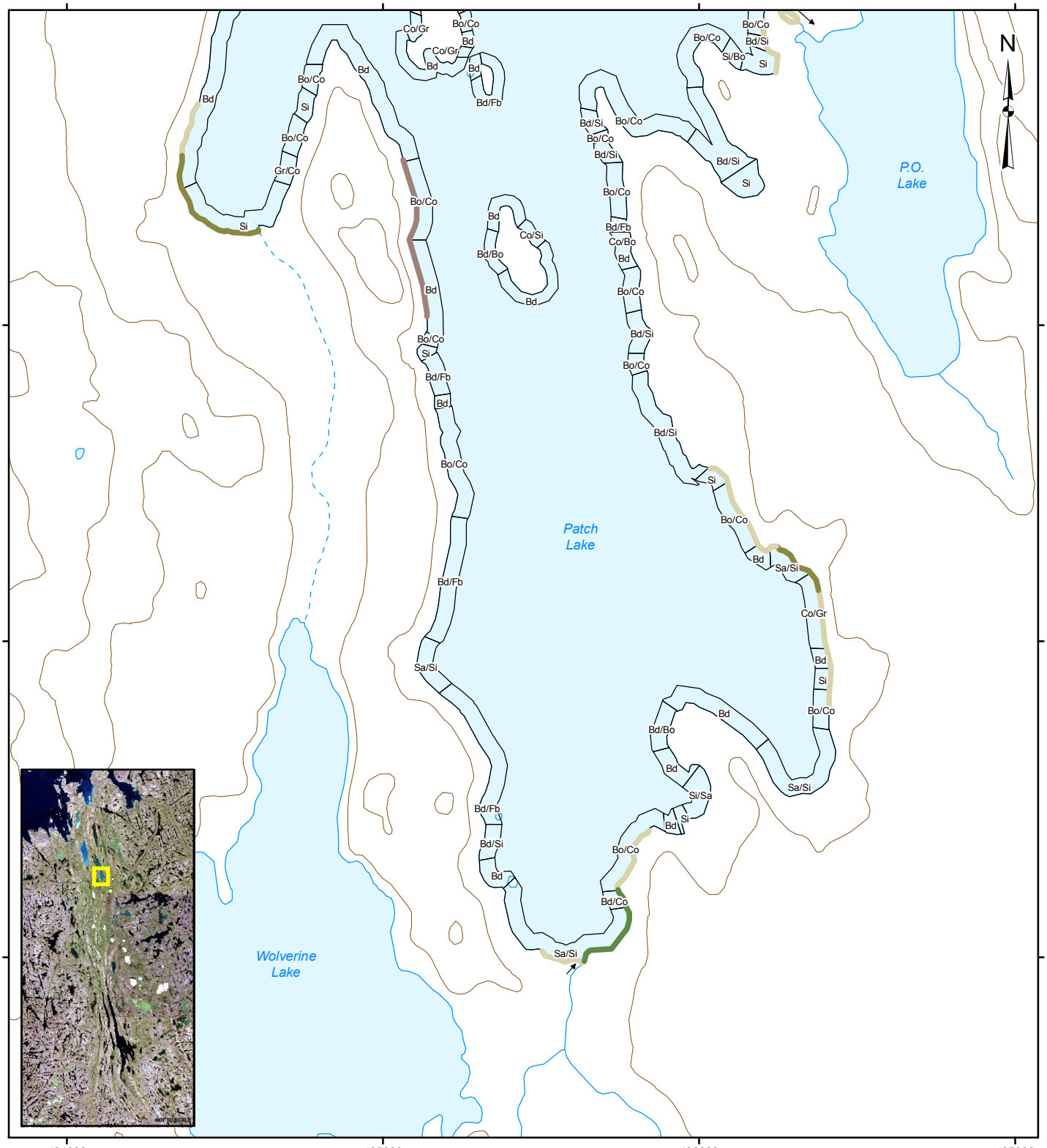


**LEGEND**

- Inundated (Flooded) Vegetation
- Overhanging Riparian Vegetation
- Riparian Shrub
- Slumping Shoreline
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Sa | SAND |
| Co | COBBLE | Si | SILT |
| Fb | FRACTURED BEDROCK | | |

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

# PATCH LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT (SOUTH END), MADRID PROJECT AREA

Golder Associates
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|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
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| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.12**

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**Photo 5.9 Bedrock Outcrop on East Shore of Patch Lake, 2006**

**Photo 5.10 Gravel and Sand Beach on the North-West End of Patch Lake, 2006**

The majority of the Patch Lake riparian shoreline was identified as bare; however, cover for fish was present in areas of overhanging shrubs noted along the peninsula projecting off the north shore, along the east shoreline, and along

the west shoreline of the southern basin. Two small bands of inundated shrubs were identified in low areas adjacent to slumping shoreline (Figures 5.11 and 5.12).

### 5.2.2.3 P.O. Lake

P.O. Lake is a small lake (84 ha), with a maximum depth of approximately 5.6 m (Table 5.6). Approximately 35 ha in the lake exist between 2 and 3 m depth and about 33 ha of the lake are less than 2 m deep (Figure 5.13). Based on the bathymetry data, P.O. Lake has a basin volume of approximately $1.8 \times 10^6$ $m^3$ (Figure 5.14). P.O. Lake has inflows from Patch Lake to the west, P.O. Inflow Lake to the north, and a small stream at the south end of the lake. P.O. Lake drains north into P.O. Connector Lake, which flows north into Ogama Lake.

**Table 5.6 Physical Properties of P.O. Lake**

| | |
|---|---|
| **Area** | 84 ha |
| **Volume** | $1.81 \times 10^6$ $m^3$ |
| **Maximum depth** | 5.6 m |
| **Mean depth** | 2.2 m |
| **Length (fetch)** | 2305 m |
| **Maximum width** | 525 m |
| **Shoreline length** | 5750 m |

Prepared by: SJ Checked by: AH

The nearshore substrate is composed primarily of silt (Si), with some areas of bedrock (Bd) and cobble (Co) or composite types including gravel and sand (Figure 5.15). P.O. Lake contains very little suitable habitat for salmonid rearing, but does contain plenty of habitat suitable for coregonid feeding and rearing. The habitat units presented in Figure 5.15 are for display purposes only, and do not represent the actual extent of the habitat units.

Fish cover was abundant along the shoreline of P.O. Lake. Emergent macrophytes were noted near the inflow. The majority of the shoreline is vegetated with shrubs. The west shore has areas of unstable slumping banks (Figure 5.15; Photo 5.11). Overhanging shrubs are present on the north-west shore of the lake (Photo 5.12), and a few small areas of inundated vegetation and emergent aquatic vegetation are also present in P.O. Lake.

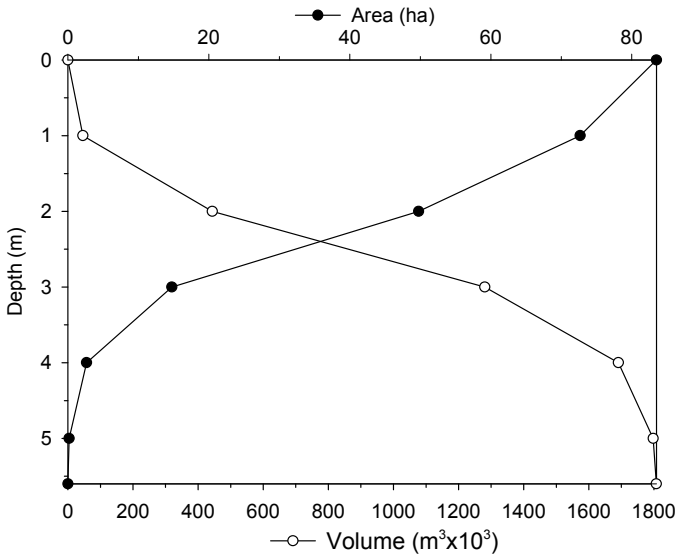
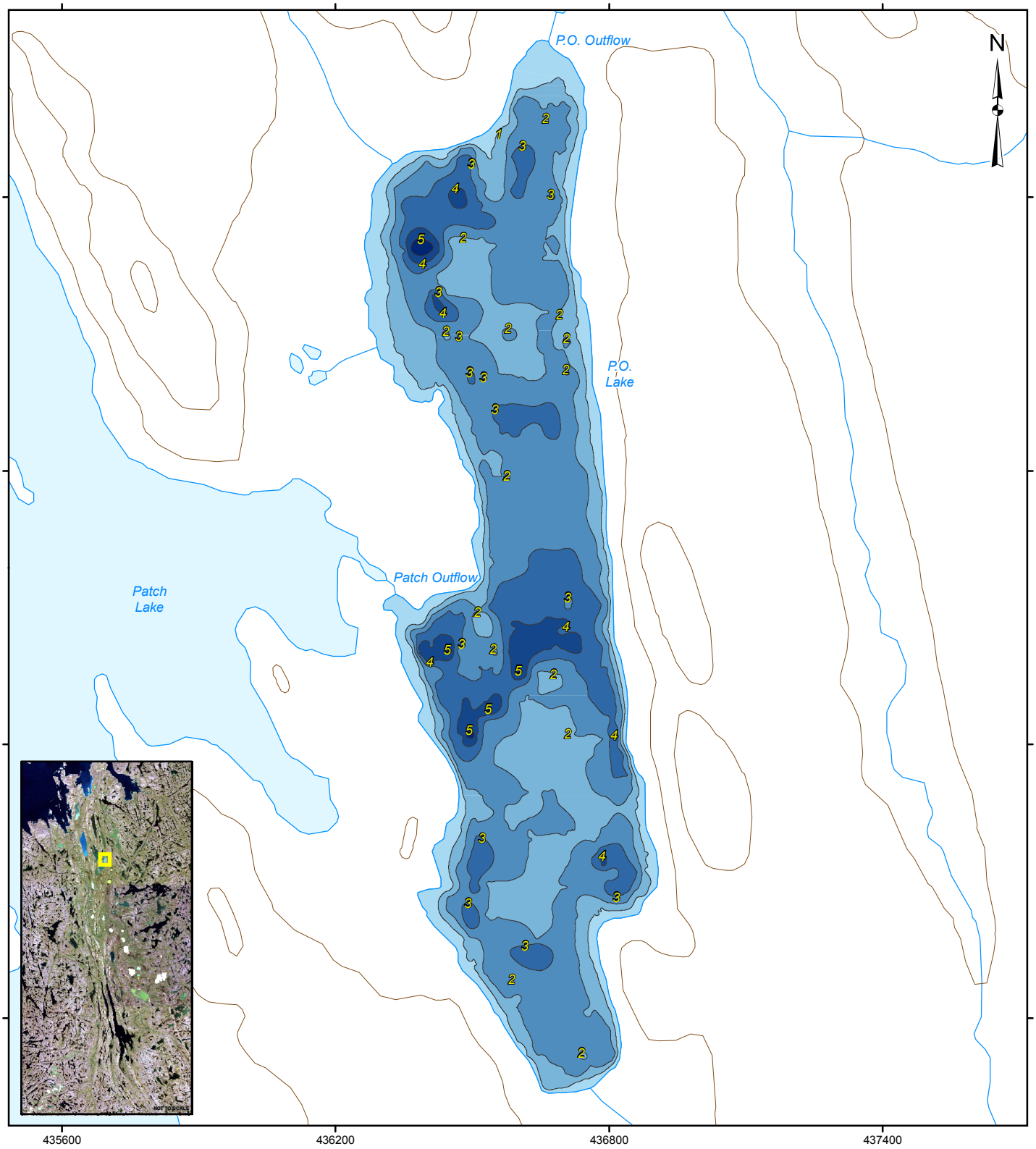



**Figure 5.13 Depth – Area and Volume Hypsograph of P.O. Lake**

**Photo 5.11 Slumping Banks on East Shore of P.O. Lake, 2006**




**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

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HOPE BAY MINING LTD.

TITLE

**P.O. LAKE BATHYMETRY**
**MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 5 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
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**FIGURE: 5.14**

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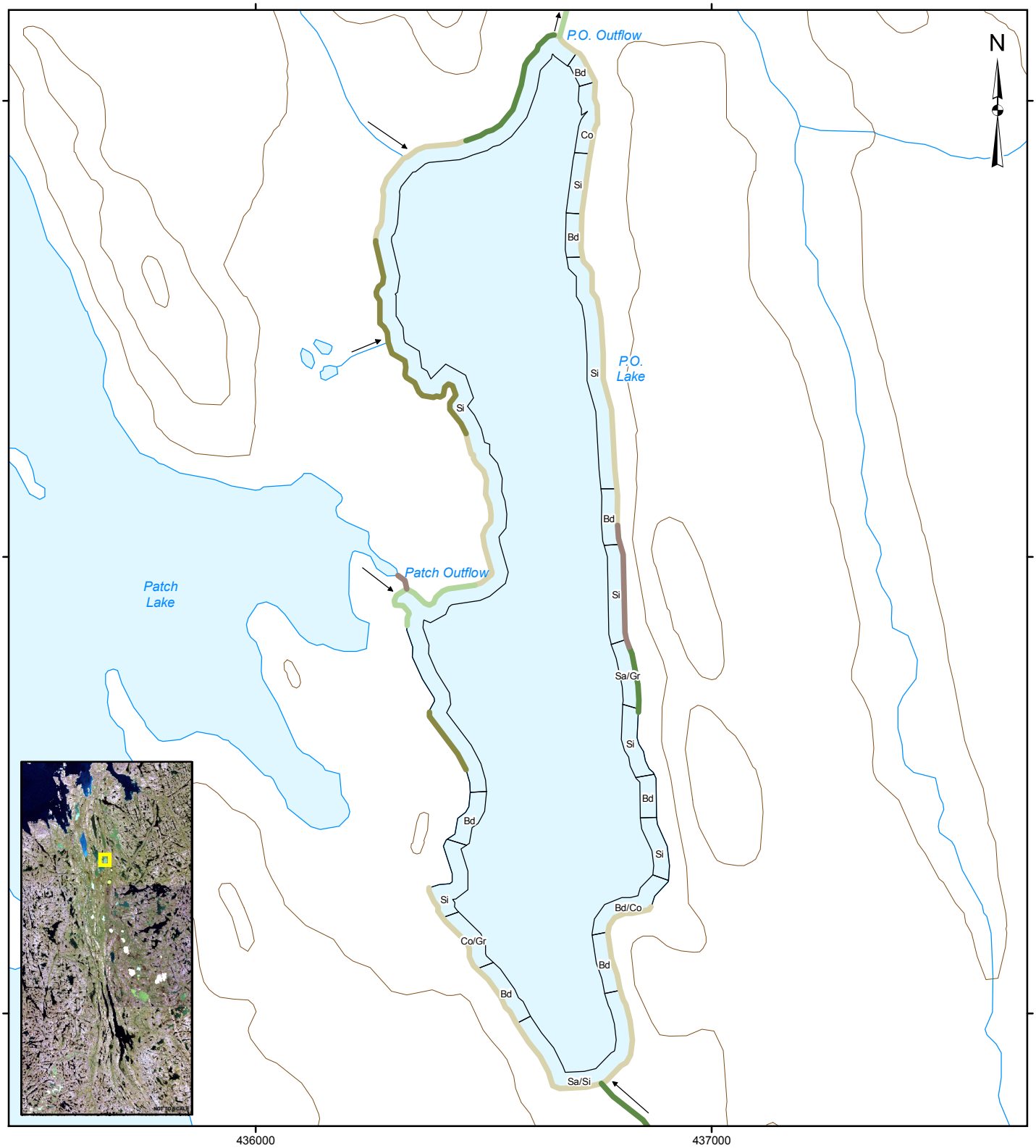


**LEGEND**

- EMERGENT MACROPHYTE
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN SHRUB
- SLUMPING SHORELINE
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Sa | SAND |
| Co | COBBLE | Si | SILT |

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
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**P.O. LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

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| DESIGN | AH | 28 Oct. 2008 | | |
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| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.15**

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**Photo 5.12 Overhanging Vegetation on the West Shore of P.O. Lake, 2006**

### 5.2.2.4 P.O. Connector Lake

P.O. Connector Lake is a very small, shallow lake between P.O. Lake and Ogama Lake (Table 5.7). Over half of the lake is less than 4.5 m deep and about one-third of the lake is between 2 and 4 m deep (Figure 5.16). The volume of P.O. Connector Lake is approximately 9.71 x $10^4$ $m^3$ based on the bathymetry data (Figure 5.17).

**Table 5.7 Physical Properties of P.O. Connector Lake**

| | |
|---|---|
| **Area** | 6.2 ha |
| **Volume** | 9.71 x $10^4$ $m^3$ |
| **Maximum depth** | 4.5 m |
| **Mean depth** | 2.2 m |
| **Length (fetch)** | 470 m |
| **Maximum Width** | 165 m |
| **Shoreline length** | 1115 m |

Prepared by: SJ Checked by: AH

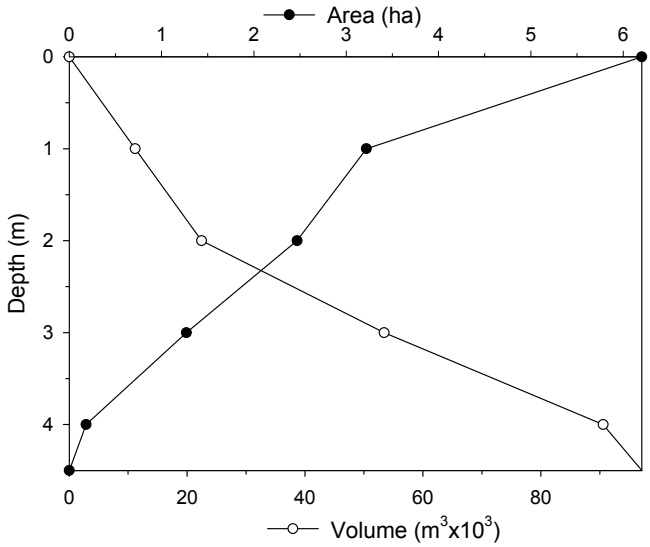


**Figure 5.16 Depth - Area and Volume Hypsograph of P.O. Connector Lake**

The majority of the shoreline substrate consisted of bedrock (Bd) and boulders (Bo) with areas of silt (Si) at both the north and south ends of the lake (Figure 5.18; Photo 5.13). Bedrock does not provide quality fish habitat, though the small boulder areas may provide suitable feeding and rearing habitat for lake trout and coregonids. The silt areas may also provide suitable feeding and rearing areas for coregonid species. The offshore extent of the habitat units depicted in Figure 5.18 are for display purposes, and do not represent the true extent of the habitat units. The basin was primarily composed of silt or soft substrates below 2 m depth (unpublished file data).

Cover for fish was provided by overhanging shrubs along the west shore of the lake and by emergent aquatic macrophytes at the north end of the lake near the outflow (Figure 5.18; Photo 5.14).

**LEGEND**

- ISOBATH
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY

**WATER DEPTH (m)**

0 1 2 3 4 5

SCALE 1:3000

100 0 100

METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

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**MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

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| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.17**

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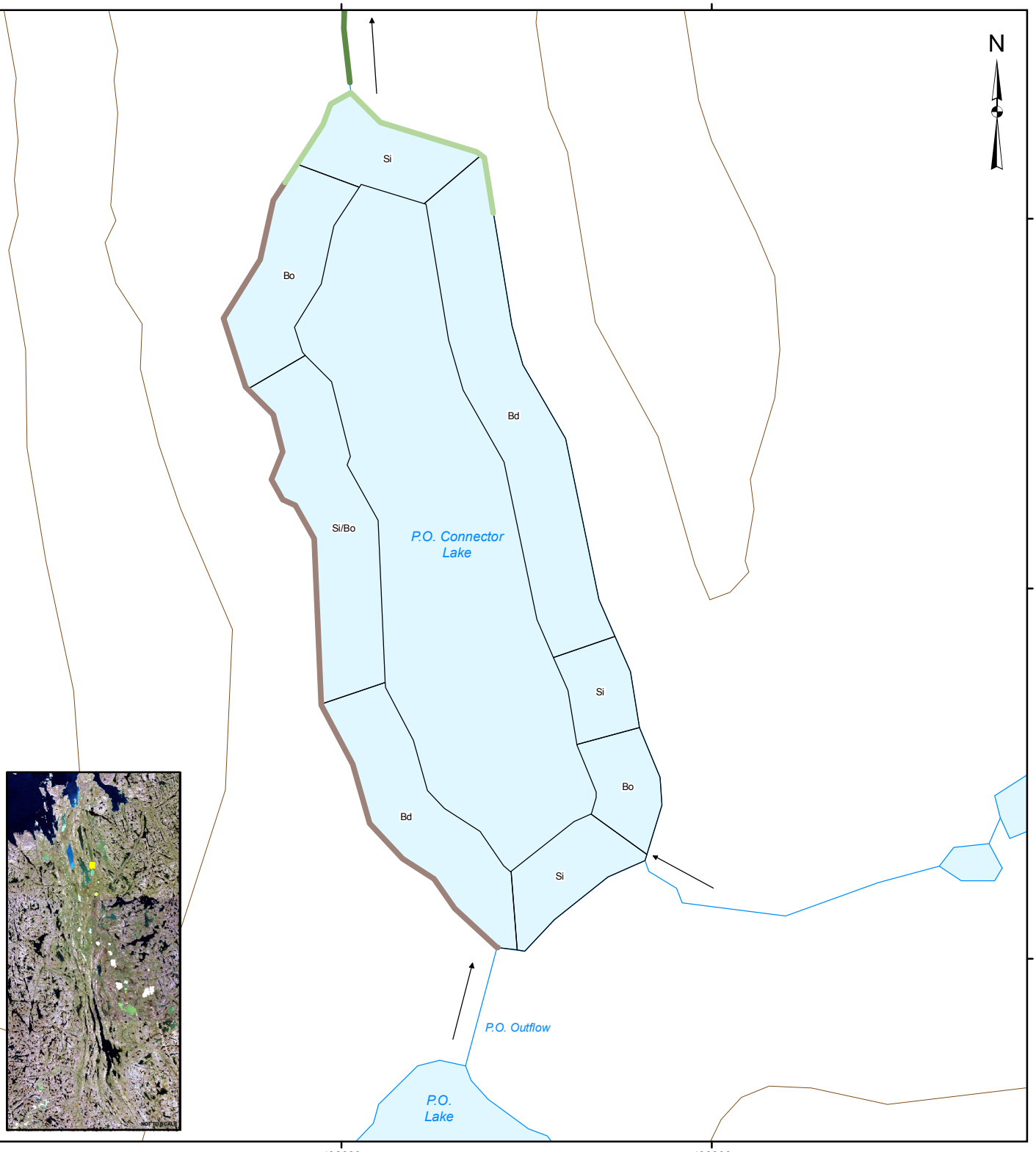


**LEGEND**

- EMERGENT MACROPHYTE
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN SHRUB
- SLUMPING SHORELINE
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Sa | SAND |
| Co | COBBLE | Si | SILT |

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

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TITLE

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Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
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| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.18**

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**Photo 5.13 Bedrock on East Shore of P.O. Connector Lake, 2006**

**Photo 5.14 Submerged Aquatic Vegetation on the South Shore of P.O. Connector Lake, 2006**

### 5.2.2.5 P.O. Inflow Lake

P.O. Inflow Lake is a small (16 ha), shallow (maximum depth estimated at 2 m) lake north of P.O. Lake (Table 5.8). Bathymetric contour information was not available for P.O. Inflow Lake, therefore the lake volume could not be calculated. P.O. Inflow Lake does not have any substantial inflow streams and is primarily fed by surface runoff. P.O. Inflow Lake drains into P.O. Lake.

**Table 5.8 Physical Properties of P.O. Inflow Lake**

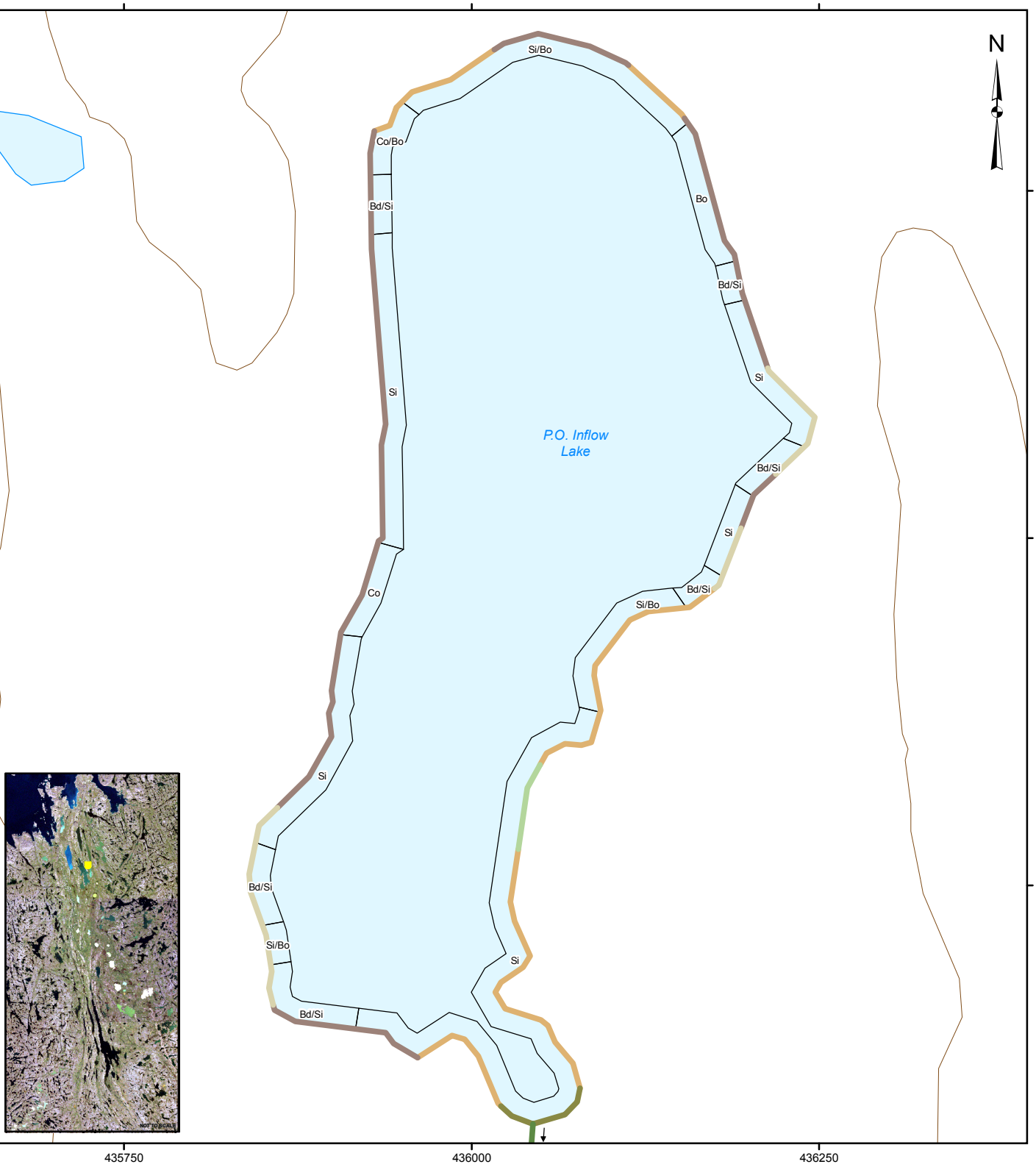
| | |
|---|---|
| **Area** | 16 ha |
| **Maximum depth*** | > 2 m |
| **Length (fetch)** | 720 m |
| **Maximum width** | 308 m |
| **Shoreline length** | 2088 m |

Prepared by: SJ
Checked by: AH

*Bathymetry data is not available; therefore, the maximum depth is estimated from the 2006 habitat survey

The majority of the shoreline substrate is silt (Si), silt with boulder (Si/Bo) or cobble (Si/Co; Figure 5.19). The offshore extent of the habitat units depicted in Figure 5.19 are for display purposes, and do not represent the true extent of the habitat units.

A small band of emergent macrophytes were noted near the south-east shoreline. The riparian area along the shoreline is dominated by overhanging shrubs providing overhead cover for fish in the near shore littoral zone (Figure 5.19). Riparian areas along the south-east and north shores were vegetated with grasses and forbes (Photos 5.15 and 5.16).






**LEGEND**

- EMERGENT MACROPHYTE
- INUNDATED (FLOODED) VEGETATION
- OVERHANGING RIPARIAN VEGETATION
- RIPARIAN GRASS/FORB
- RIPARIAN SHRUB
- SLUMPING BANK
- CONTOUR (20 m INTERVAL)
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Si | SILT |
| Co | BEDROCK | | |

125 0 125

SCALE 1:4000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**P.O. INFLOW LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, MADRID PROJECT AREA**

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.19**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig5_19_AQ_HB_POInflow_Madrid08_12Jan2009.mxd

**Photo 5.15 Emergent Vegetation on the North-East Shore of P.O. Inflow Lake, 2006**

**Photo 5.16 Shoreline Vegetation on the South-East Shore of P.O. Inflow Lake, 2006**

### 5.2.2.6 Wolverine Lake

Wolverine Lake is located to the south-west of Patch Lake. Wolverine Lake is a shallow lake with a maximum depth of approximately 4.7 m and an area of 100 ha (Table 5.9). Approximately half of the lake is less than 2 m deep and about 37 ha (slightly more than one-third) of the lake area is between 2 and 3 m deep (Figure 5.20). Based on the bathymetry data, Wolverine Lake has a volume of approximately 2.09 x$10^6$ $m^3$ (Figure 5.21). Wolverine Lake does not have substantial inflow or outflow streams, and primarily receives water from surface runoff. The outflow of Wolverine Lake is ephemeral, and appears to flow in an unconfined channel through a marsh area only during spring freshet or extreme high water events.

**Table 5.9 Physical Properties of Wolverine Lake**

| | |
|---|---|
| **Area** | 100 ha |
| **Volume** | 2.09 x $10^6$ $m^3$ |
| **Maximum depth** | 4.7 m |
| **Mean depth** | 2.1 m |
| **Length (fetch)** | 1875 m |
| **Maximum width** | 980 m |
| **Shoreline length** | 6146 m |

Prepared by: SJ Checked by: AH

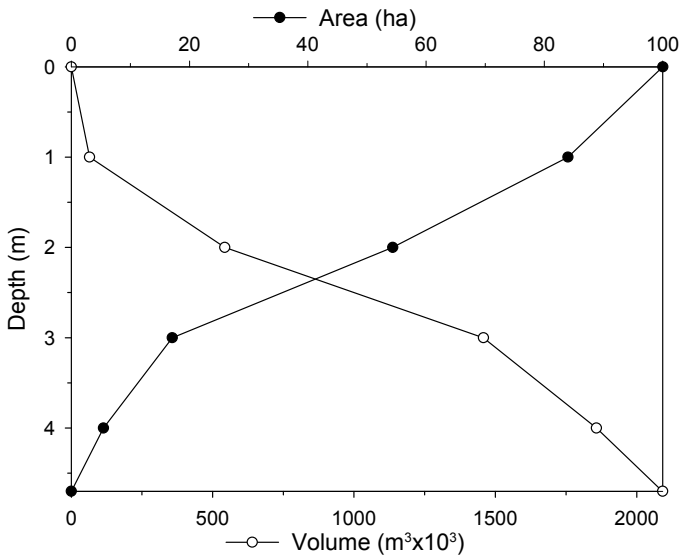
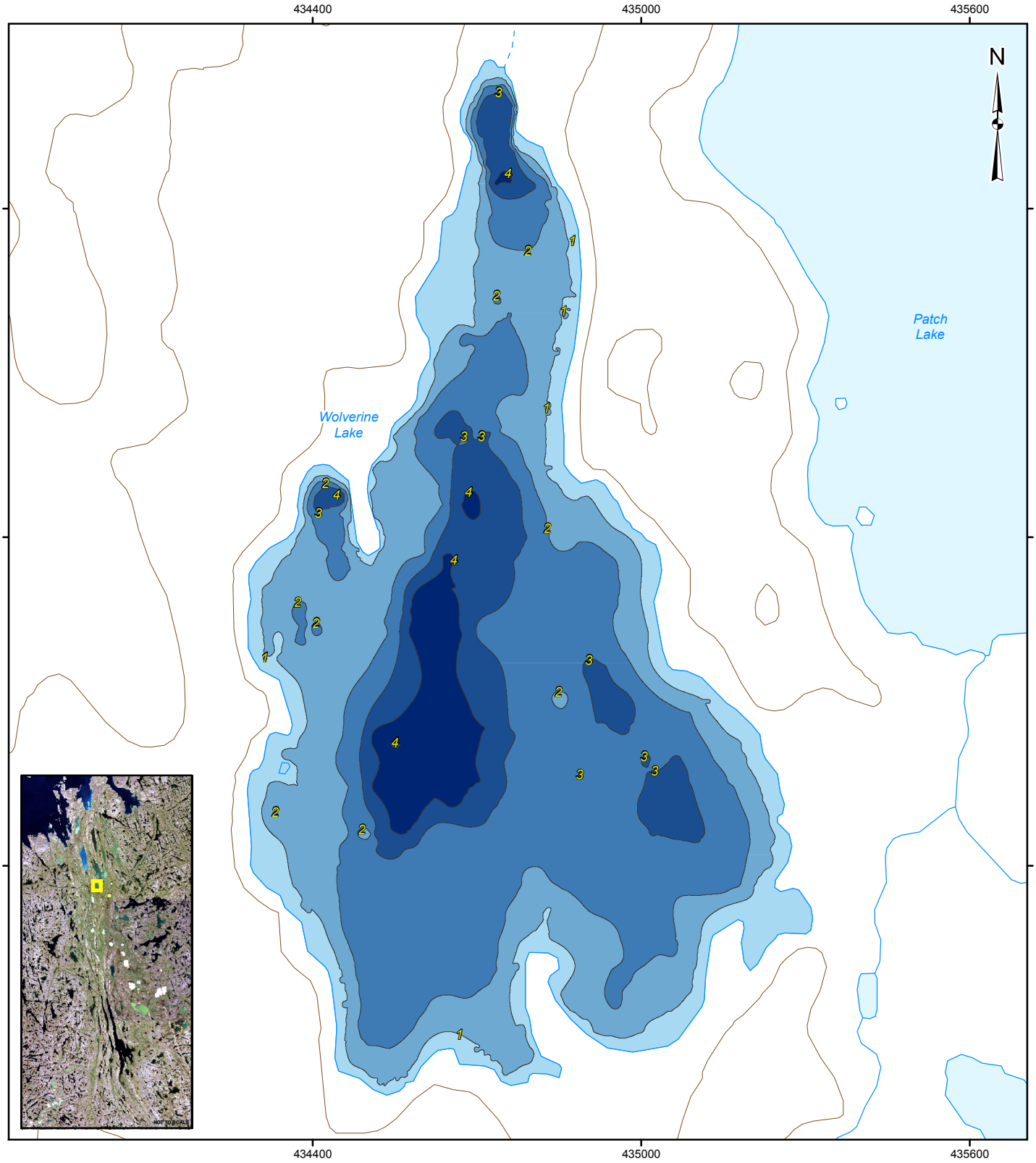



**Figure 5.20 Depth – Area and Volume Hypsograph of Wolverine Lake**




**LEGEND**

- ISOBATH
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY

**WATER DEPTH (m)**

0 1 2 3 4 5

300 0 300

SCALE 1:10000 METRES

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT The Gold Company

HOPE BAY MINING LTD.

TITLE

# WOLVERINE LAKE BATHYMETRY MADRID PROJECT AREA

Golder Associates Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 5 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

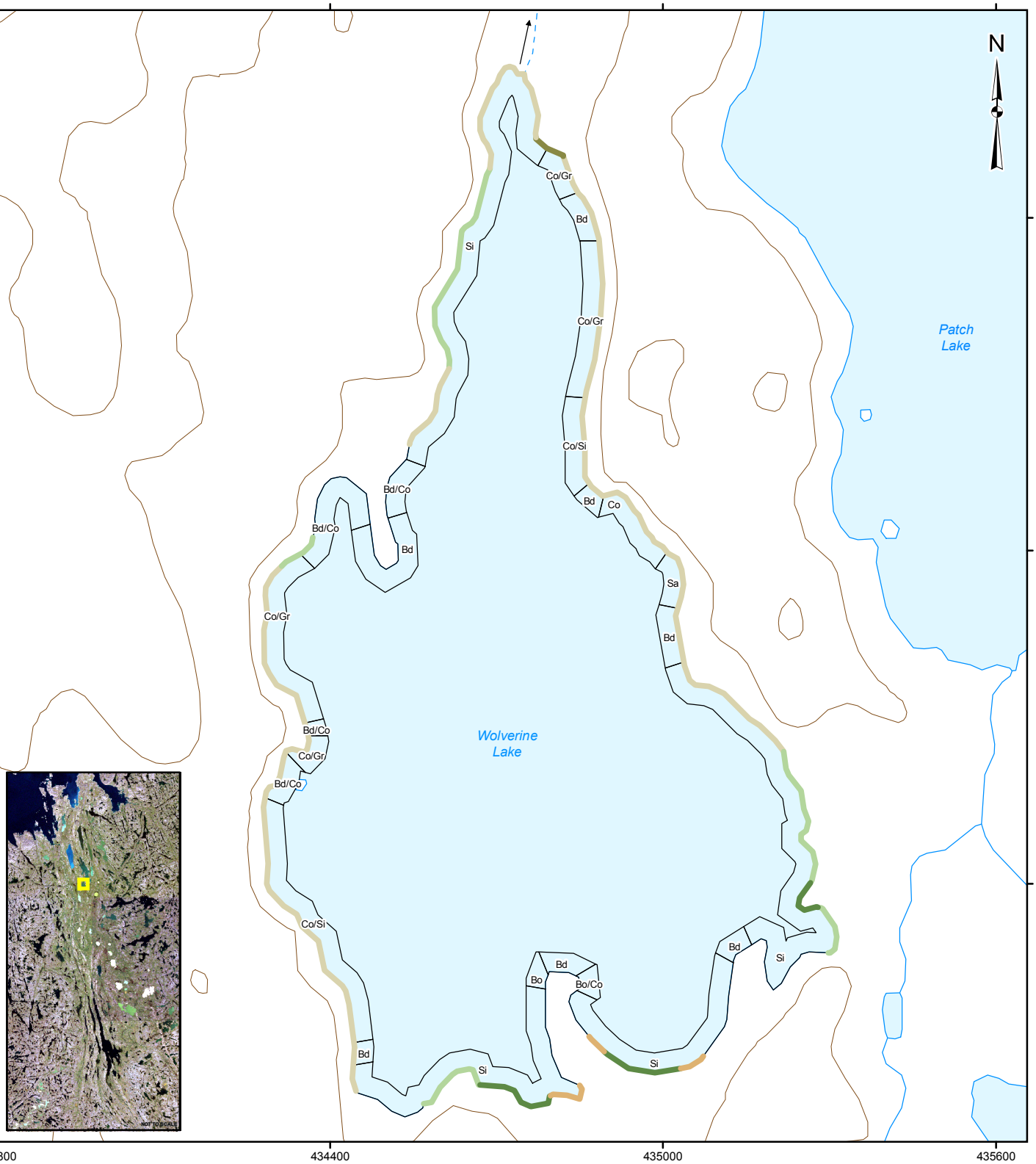
**FIGURE: 5.21**

M:\Projects\2008\1373\0026_HBML_Doris_North_Environmental_Programs\MapDocs\mxd\Current\Fig5_21_AQ_BM_Wolverine_Madrid08_12Jan2009.mxd

The shoreline substrate is dominated by silt (Si), however, bedrock (Bd), cobble (Co), and composite types of coarse substrates (cobble, boulder, and gravel; Figure 5.22; Photo 5.17) are also abundant. These coarse substrate areas would provide suitable feeding and rearing habitat for the least cisco population in the lake. The offshore extent of the habitat units depicted on Figure 5.22 are for display purposes, and do not represent the true extent of the habitat units.

Fish cover was abundant in Wolverine Lake. The majority of the shoreline is vegetated with shrubs. The south shore has inundated vegetation, grass/forbs and some emergent aquatic vegetation. A small area on the south-east shore has emergent vegetation and grass/forbs (Figure 5.22; Photo 5.18).

**Photo 5.17 Cobble Substrate on North-East Shore of Wolverine Lake, 2006**




**LEGEND**

- EMERGENT MACROPHYTE
- INUNDATED (FLOODED) VEGETATION
- RIPARIAN GRASS/FORB
- RIPARIAN SHRUB
- SLUMPING SHORELINE
- CONTOUR (20 m INTERVAL)
- INTERMITTENT STREAM
- WATERCOURSE
- WATERBODY
- NEARSHORE SUBSTRATE ZONE

| | | | |
|---|---|---|---|
| Bd | BEDROCK | Gr | GRAVEL |
| Bo | BOULDER | Sa | SAND |
| Co | BEDROCK | Si | SILT |

**REFERENCE**

Base data obtained from Government of Canada, Natural Resources Canada, Centre for Topographic Information (1:50 000). Landsat 7 imagery capture in 2007, obtained from CanImage. Field data collected by Golder Associates Ltd., 2006.
Projection: UTM Zone 13 Datum: NAD 83

PROJECT

NEWMONT. The Gold Company

HOPE BAY MINING LTD.

TITLE

**WOLVERINE LAKE NEARSHORE SUBSTRATE AND RIPARIAN HABITAT, MADRID PROJECT AREA**

Golder Associates
Edmonton, Alberta

| PROJECT NO. 08-1373-0026 | | | SCALE AS SHOWN | REV. 3 |
|---|---|---|---|---|
| DESIGN | AH | 28 Oct. 2008 | | |
| GIS | RC | 12 Jan. 2009 | | |
| CHECK | AH | 12 Jan. 2009 | | |
| REVIEW | GA | 12 Jan. 2009 | | |

**FIGURE: 5.22**

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**Photo 5.18 Emergent Aquatic Vegetation at the South-East End of Wolverine Lake, 2006**

# 6 CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

**GOLDER ASSOCIATES LTD.**

Report prepared by:

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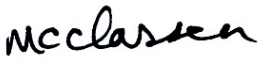

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# APPENDIX A1

# HYDROLOGY DATA FOR BOSTON PROJECT AREA

# A1 HYDROLOGY DATA FOR BOSTON PROJECT AREA

This appendix contains hydrology data referenced in the body of the report. A table of contents for the appendix follows:


| Station | Description | Page |
|---|---|---|
| **HYDROMETRY** | | |
| H83 – Aimaokatalok River | Factsheet | A1-3 |
| | Stage-Discharge Rating Curve (2008) | A1-4 |
| | Stage-Discharge Data (2008) | A1-4 |
| | Mean Daily Discharge and Water Level Data (2008) | A1-5 |
| | Discharge Data Sheets (2008) | A1-6 |
| H84 – Aimaokatalok Lake | Factsheet | A1-8 |
| and Outflow | Stage-Discharge Rating Curve (2008) | A1-9 |
| | Stage-Discharge Data (2008) | A1-9 |
| | Mean Daily Discharge and Water Level Data (2007) | A1-10 |
| | Mean Daily Discharge and Water Level Data (2008) | A1-11 |
| H86 – Fickle Duck Lake | Factsheet | A1-12 |
| and Outflow | Stage-Discharge Rating Curve (2008) | A1-13 |
| | Stage-Discharge Data (2008) | A1-13 |
| | Mean Daily Discharge and Water Level Data (2008) | A1-14 |
| | Discharge Data Sheets (2008) | A1-15 |
| H85 – Koignuk River | Factsheet | A1-19 |
| | Stage-Discharge Rating Curve (2008) | A1-20 |
| | Stage-Discharge Data (2008) | A1-20 |
| | Mean Daily Discharge and Water Level Data (2008) | A1-21 |
| H87 – Stickleback Lake | Factsheet | A1-22 |
| and Outflow | Stage-Discharge Rating Curve (2008) | A1-23 |
| | Stage-Discharge Data (2008) | A1-23 |
| | Mean Daily Discharge and Water Level Data (2008) | A1-24 |
| | Discharge Data Sheets (2008) | A1-25 |
| **SNOW COURSE SURVEY** | | |
| Open Lake Plots | Snow Course Survey Data and Calculations | A1-29 |
| Exposed Lowland Plots | Snow Course Survey Data and Calculations | A1-30 |
| Sheltered Lowland Plots | Snow Course Survey Data and Calculations | A1-31 |
| North Aspect Plots | Snow Course Survey Data and Calculations | A1-32 |
| East Aspect Plots | Snow Course Survey Data and Calculations | A1-33 |
| South Aspect Plots | Snow Course Survey Data and Calculations | A1-34 |
| West Aspect Plots | Snow Course Survey Data and Calculations | A1-35 |

# AIMAOKATALOK RIVER HYDROMETRIC STATION

**H83**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on the right downstream bank of Aimaokatalok River, approximately 200 m upstream of Aimaokatalok Lake during high water. Not accessible by boat during low water.

| Operational: | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| | 2/6-10/9 | 26/5-9/9 | 24/6-11/9 | |

Benchmark: Top of embedded boulder, 100.048 m (local); Drainage Area: 769 km$^2$

Coordinates: UTM: 441634 m E, 7499360 m N (Zone 13W NAD83) Lat/Long: 67°36'14" N, 106°22'22" W

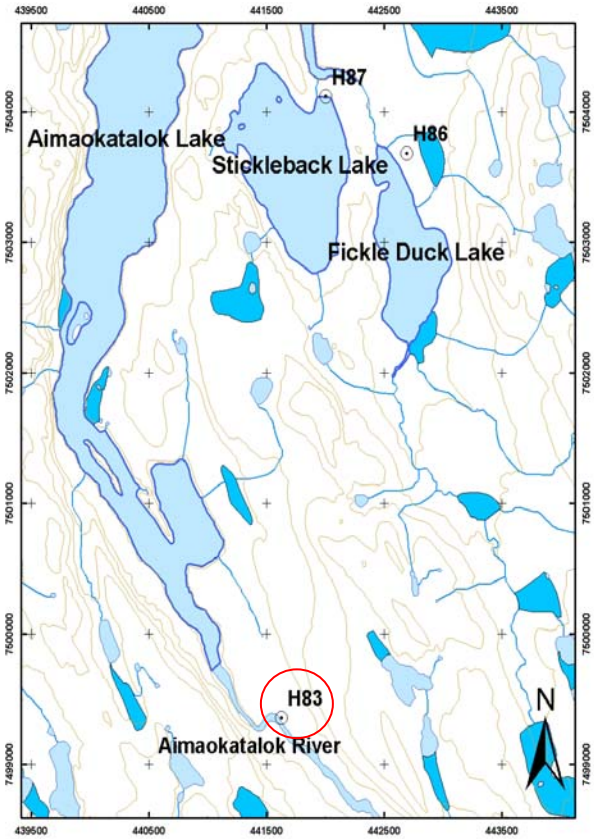
Instruments: Optimum Instruments Datalogger, Keller Transducer

Station H83 looking west from right bank at low water.

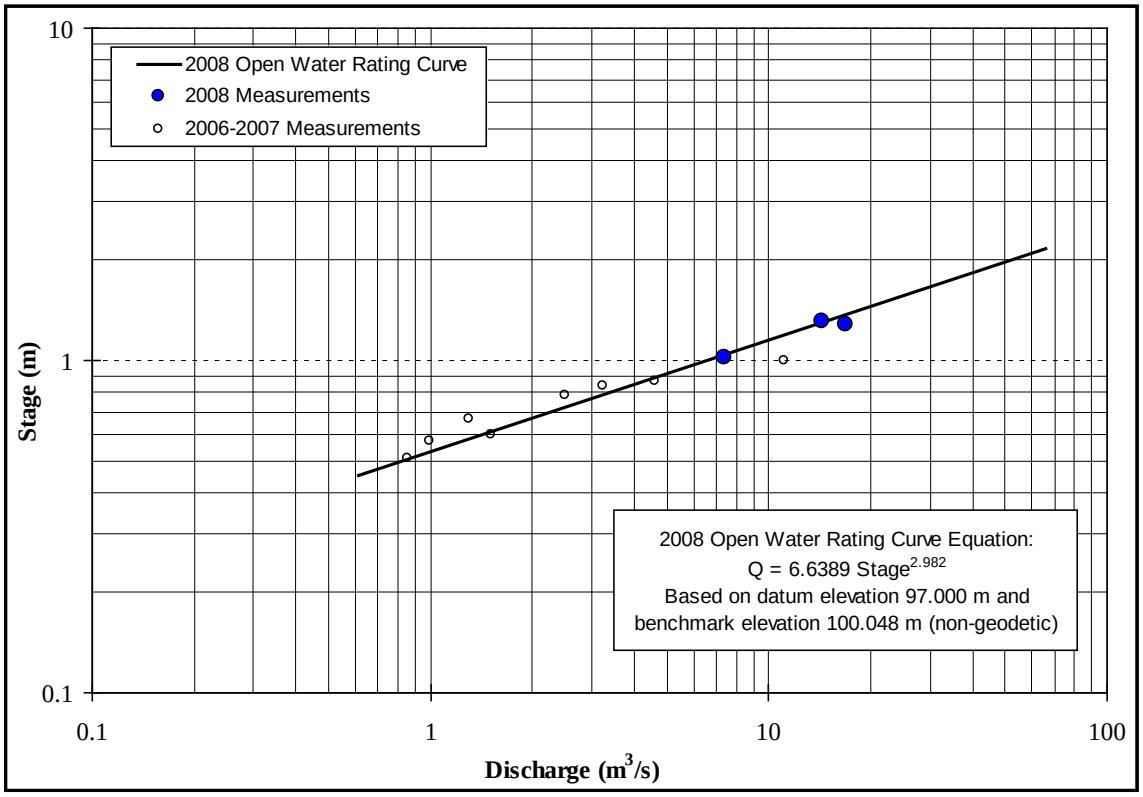
Station H83 looking west (downstream).

Station H83 looking west from right bank at high water.

Station H83 looking northwest (downstream).




NTS Mapping of Area.




**Aimaokatalok River Station H83 – Stage-Discharge Rating Curve (2008)**

## Aimaokatalok River Station H83 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 06-Jul-2008 14:25 | 98.282 | 0.769 | 97.513 | 97.501 | 1.282 | 16.900 [a] |
| 11-Aug-2008 14:55 | 98.127 | 0.525 | 97.602 | | 1.127 | 7.373 |
| 11-Sep-2008 14:25 | 98.209 | 0.820 | 97.389 | | 1.209 | 14.314 |

[a] Discharge measurement with ADCP (see Appendix A4).

## H83 Aimaokatalok River – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 22.07 | 9.43 | 21.97 | 4.42 E | - | - |
| 2 | - | - | - | - | - | - | 19.32 | 8.89 | 24.98 | 4.08 E | - | - |
| 3 | - | - | - | - | - | - | 17.54 | 8.27 | 25.70 | 3.57 E | - | - |
| 4 | - | - | - | - | - | - | 17.00 | 8.07 | 25.45 | 3.17 E | - | - |
| 5 | - | - | - | - | - | - | 15.45 | 7.76 | 24.17 | 2.80 E | - | - |
| 6 | - | - | - | - | - | - | 14.11 | 7.82 | 22.34 | 2.32 E | - | - |
| 7 | - | - | - | - | - | - | 12.64 | 7.69 | 20.42 | 1.89 E | - | - |
| 8 | - | - | - | - | - | - | 11.74 | 7.29 | 18.84 | 1.51 E | - | - |
| 9 | - | - | - | - | - | - | 10.66 | 7.02 | 17.57 | 1.21 E | - | - |
| 10 | - | - | - | - | - | - | 9.64 | 6.89 | 16.62 | 0.94 E | - | - |
| 11 | - | - | - | - | - | - | 8.95 | 7.23 | 15.57 P | 0.75 E | - | - |
| 12 | - | - | - | - | - | - | 8.33 | 8.89 | 14.69 E | 0.57 E | - | - |
| 13 | - | - | - | - | - | - | 7.77 | 8.81 | 13.93 E | 0.34 E | - | - |
| 14 | - | - | - | - | - | - | 7.26 | 8.71 | 13.27 E | 0.23 E | - | - |
| 15 | - | - | - | - | - | - | 6.70 | 10.26 | 12.71 E | 0.19 E | - | - |
| 16 | - | - | - | - | - | - | 6.21 | 10.85 | 12.13 E | 0.14 E | - | - |
| 17 | - | - | - | - | - | - | 5.84 | 11.16 | 11.54 E | 0.09 E | - | - |
| 18 | - | - | - | - | - | - | 5.57 | 10.98 | 10.95 E | - | - | - |
| 19 | - | - | - | - | - | - | 5.50 | 10.90 | 10.41 E | - | - | - |
| 20 | - | - | - | - | - | - | 5.33 | 11.09 | 9.87 E | - | - | - |
| 21 | - | - | - | - | - | - | 5.04 | 10.96 | 9.33 E | - | - | - |
| 22 | - | - | - | - | - | - | 5.66 | 10.70 | 8.79 E | - | - | - |
| 23 | - | - | - | - | - | - | 6.26 | 10.69 | 8.25 E | - | - | - |
| 24 | - | - | - | - | - | 62.17 P | 5.70 | 10.58 | 7.71 E | - | - | - |
| 25 | - | - | - | - | - | 53.50 | 6.19 | 10.11 | 7.17 E | - | - | - |
| 26 | - | - | - | - | - | 42.73 | 10.82 | 9.69 | 6.63 E | - | - | - |
| 27 | - | - | - | - | - | 35.91 | 10.01 | 10.83 | 6.09 E | - | - | - |
| 28 | - | - | - | - | - | 30.55 | 9.71 | 11.09 | 5.55 E | - | - | - |
| 29 | - | - | - | - | - | 27.41 | 9.85 | 13.18 | 5.15 E | - | - | - |
| 30 | - | - | - | - | - | 24.42 | 9.89 | 16.24 | 4.79 E | - | - | - |
| 31 | - | - | - | - | - | - | 9.71 | 18.41 | - | - | - | - |
| MIN | - | - | - | - | - | 24.415 | 5.039 | 6.892 | 4.790 | - | - | - |
| MEAN | - | - | - | - | - | 39.526 | 9.886 | 10.016 | 13.753 | - | - | - |
| MAX | - | - | - | - | - | 62.174 | 22.067 | 18.406 | 25.698 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.048 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 98.50 | 98.125 | 98.493 | - | - | - |
| 2 | - | - | - | - | - | - | 98.43 | 98.103 | 98.560 | - | - | - |
| 3 | - | - | - | - | - | - | 98.38 | 98.076 | 98.574 | - | - | - |
| 4 | - | - | - | - | - | - | 98.37 | 98.068 | 98.569 | - | - | - |
| 5 | - | - | - | - | - | - | 98.33 | 98.054 | 98.542 | - | - | - |
| 6 | - | - | - | - | - | - | 98.29 | 98.056 | 98.502 | - | - | - |
| 7 | - | - | - | - | - | - | 98.24 | 98.050 | 98.458 | - | - | - |
| 8 | - | - | - | - | - | - | 98.21 | 98.032 | 98.419 | - | - | - |
| 9 | - | - | - | - | - | - | 98.17 | 98.019 | 98.386 | - | - | - |
| 10 | - | - | - | - | - | - | 98.13 | 98.013 | 98.360 | - | - | - |
| 11 | - | - | - | - | - | - | 98.11 | 98.029 | 98.331 P | - | - | - |
| 12 | - | - | - | - | - | - | 98.08 | 98.103 | | - | - | - |
| 13 | - | - | - | - | - | - | 98.05 | 98.099 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.03 | 98.095 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.00 | 98.157 | - | - | - | - |
| 16 | - | - | - | - | - | - | 97.98 | 98.179 | - | - | - | - |
| 17 | - | - | - | - | - | - | 97.96 | 98.190 | - | - | - | - |
| 18 | - | - | - | - | - | - | 97.94 | 98.184 | - | - | - | - |
| 19 | - | - | - | - | - | - | 97.94 | 98.181 | - | - | - | - |
| 20 | - | - | - | - | - | - | 97.93 | 98.188 | - | - | - | - |
| 21 | - | - | - | - | - | - | 97.91 | 98.183 | - | - | - | - |
| 22 | - | - | - | - | - | - | 97.95 | 98.174 | - | - | - | - |
| 23 | - | - | - | - | - | - | 97.98 | 98.173 | - | - | - | - |
| 24 | - | - | - | - | - | 99.117 P | 97.95 | 98.169 | - | - | - | - |
| 25 | - | - | - | - | - | 99.012 | 97.97 | 98.151 | - | - | - | - |
| 26 | - | - | - | - | - | 98.866 | 98.18 | 98.135 | - | - | - | - |
| 27 | - | - | - | - | - | 98.761 | 98.15 | 98.178 | - | - | - | - |
| 28 | - | - | - | - | - | 98.668 | 98.14 | 98.188 | - | - | - | - |
| 29 | - | - | - | - | - | 98.609 | 98.14 | 98.258 | - | - | - | - |
| 30 | - | - | - | - | - | 98.547 | 98.14 | 98.349 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.14 | 98.408 | - | - | - | - |
| MIN | - | - | - | - | - | 98.547 | 97.912 | 98.013 | 98.331 | - | - | - |
| MEAN | - | - | - | - | - | 98.797 | 98.120 | 98.141 | 98.472 | - | - | - |
| MAX | - | - | - | - | - | 99.117 | 98.496 | 98.408 | 98.574 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Aimaokatalok River

LOCATION: South Inflow of Aimaokatalok Lake

COORDINATES: 441634 m E, 7499360 m N (NAD 83)

MEASUREMENT DATE:11 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 14:40 h

MEASUREMENT END TIME:15:30 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | 0.00 | | | 0 | 0.000 |
| 2 | 1.0 | 0.22 | | | 0 | 0.000 |
| 3 | 2.0 | 0.48 | | | 0.08 | 0.038 |
| 4 | 3.0 | 0.58 | | | 0.13 | 0.075 |
| 5 | 4.0 | 0.60 | | | 0.32 | 0.192 |
| 6 | 5.0 | 0.62 | | | 0.54 | 0.335 |
| 7 | 6.0 | 0.63 | | | 0.61 | 0.384 |
| 8 | 7.0 | 0.68 | | | 0.65 | 0.442 |
| 9 | 8.0 | 0.76 | 0.92 | 0.53 | | 0.551 |
| 10 | 9.0 | 0.74 | 0.91 | 0.59 | | 0.555 |
| 11 | 10.0 | 0.68 | | | 0.63 | 0.428 |
| 12 | 11.0 | 0.80 | 0.79 | 0.49 | | 0.512 |
| 13 | 12.0 | 0.89 | 0.88 | 0.50 | | 0.614 |
| 14 | 13.0 | 0.86 | 0.77 | 0.59 | | 0.585 |
| 15 | 14.0 | 0.78 | 0.73 | 0.45 | | 0.460 |
| 16 | 15.0 | 0.63 | | | 0.53 | 0.334 |
| 17 | 16.0 | 0.64 | | | 0.63 | 0.403 |
| 18 | 17.0 | 0.70 | | | 0.61 | 0.427 |
| 19 | 18.0 | 0.70 | | | 0.65 | 0.455 |
| 20 | 19.0 | 0.68 | | | 0.52 | 0.354 |
| 21 | 20.0 | 0.60 | | | 0.36 | 0.162 |
| 22 | 20.5 | 0.50 | | | 0.24 | 0.060 |
| 23 | 21.0 | 0.26 | | | 0.03 | 0.006 |
| Left Bank | 22.0 | 0.00 | | | 0 | 0.000 |
| | | | | | | **7.373** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Aimaokatalok River

LOCATION: South Inflow of Aimaokatalok Lake

COORDINATES: 441634 m E, 7499360 m N (NAD 83)

MEASUREMENT DATE: 11 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 14:20 h

MEASUREMENT END TIME:15:30 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 1.0 | 0.00 | | | | |
| 2 | 2.0 | 0.38 | | | 0.08 | 0.061 |
| 3 | 5.0 | 0.73 | 0.42 | 0.37 | | 0.865 |
| 4 | 8.0 | 0.78 | 0.48 | 0.34 | | 0.959 |
| 5 | 11.0 | 0.80 | 0.49 | 0.38 | | 1.044 |
| 6 | 14.0 | 0.90 | 0.50 | 0.33 | | 1.121 |
| 7 | 17.0 | 1.00 | 0.46 | 0.42 | | 1.320 |
| 8 | 20.0 | 1.02 | 0.46 | 0.32 | | 1.193 |
| 9 | 23.0 | 1.14 | 0.45 | | | 1.539 |
| 10 | 26.0 | 1.16 | 0.43 | 0.39 | | 1.427 |
| 11 | 29.0 | 1.12 | 0.39 | 0.45 | | 1.411 |
| 12 | 32.0 | 1.19 | 0.32 | 0.45 | | 1.374 |
| 13 | 35.0 | 1.04 | 0.31 | 0.44 | | 1.170 |
| 14 | 38.0 | 0.86 | 0.34 | 0.29 | | 0.813 |
| 15 | 41.0 | 0.32 | | | 0.21 | 0.235 |
| Left Bank | 45.0 | 0.00 | | | | |
| | | | | | | **14.533** |

# AIMAOKATALOK LAKE AND OUTFLOW HYDROMETRIC STATION

**H84**

**FACTSHEET**

## *LOCATION AND PURPOSE*

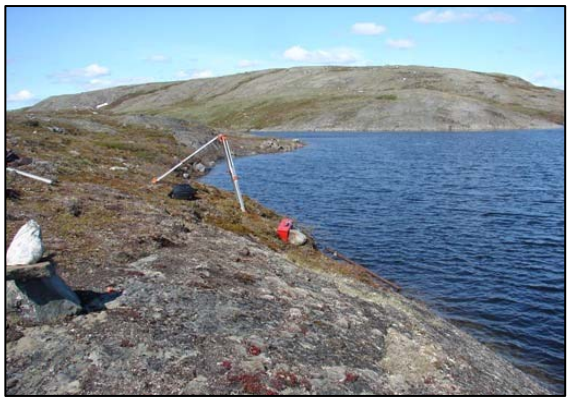
Located approximately 80 m upstream of the Aimaokatalok Lake outflow, on the left downstream bank.

| Operational: | 2006<br>8/7-31/12 | 2007<br>1/1-31/12 | 2008<br>1/1-11/09 | 2009 |
|---|---|---|---|---|

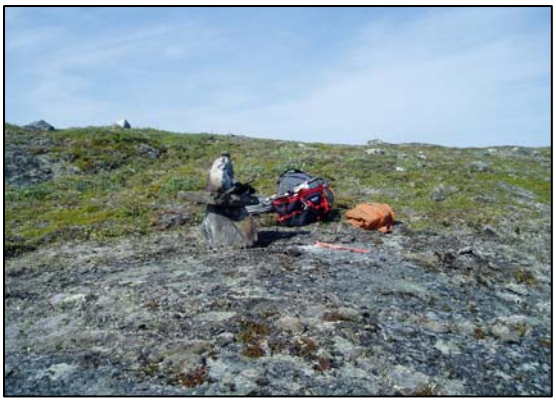
Benchmark: Top of embedded boulder, 100.000 m (local) Drainage Area: 1241 km$^2$

Coordinates: UTM: 438892 m E, 7508794 m N (Zone 13W NAD83) Lat/Long: 67°41'17" N, 106°26'33" W

Instruments: Optimum Instruments Datalogger, Keller Acculevel Transducer

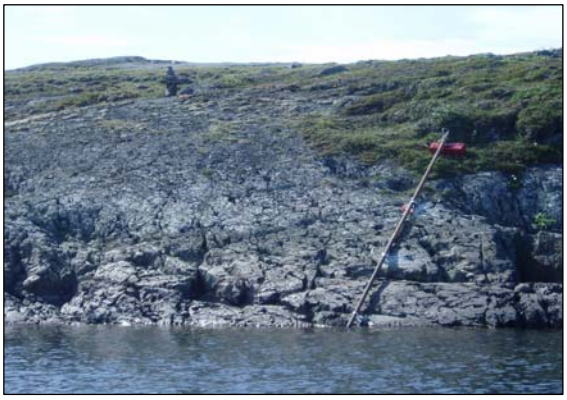


Station H84 looking north to lake outlet.

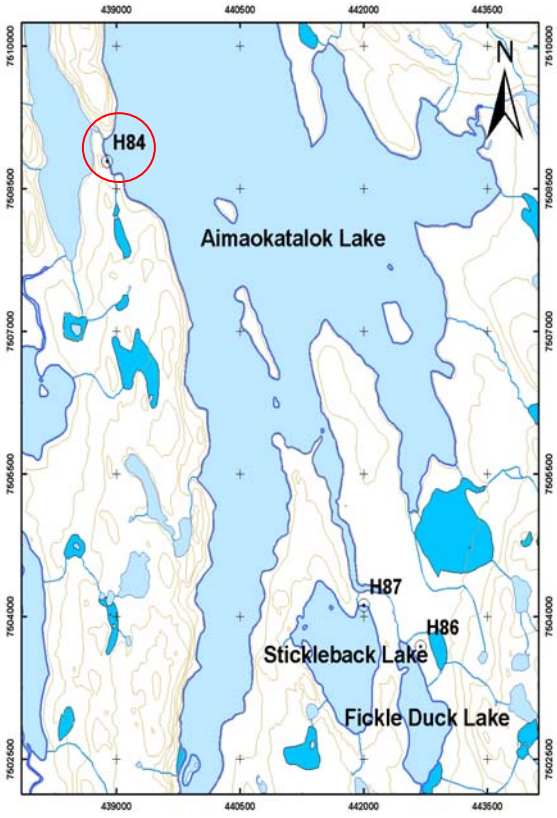


Station H84 upper benchmark looking west.

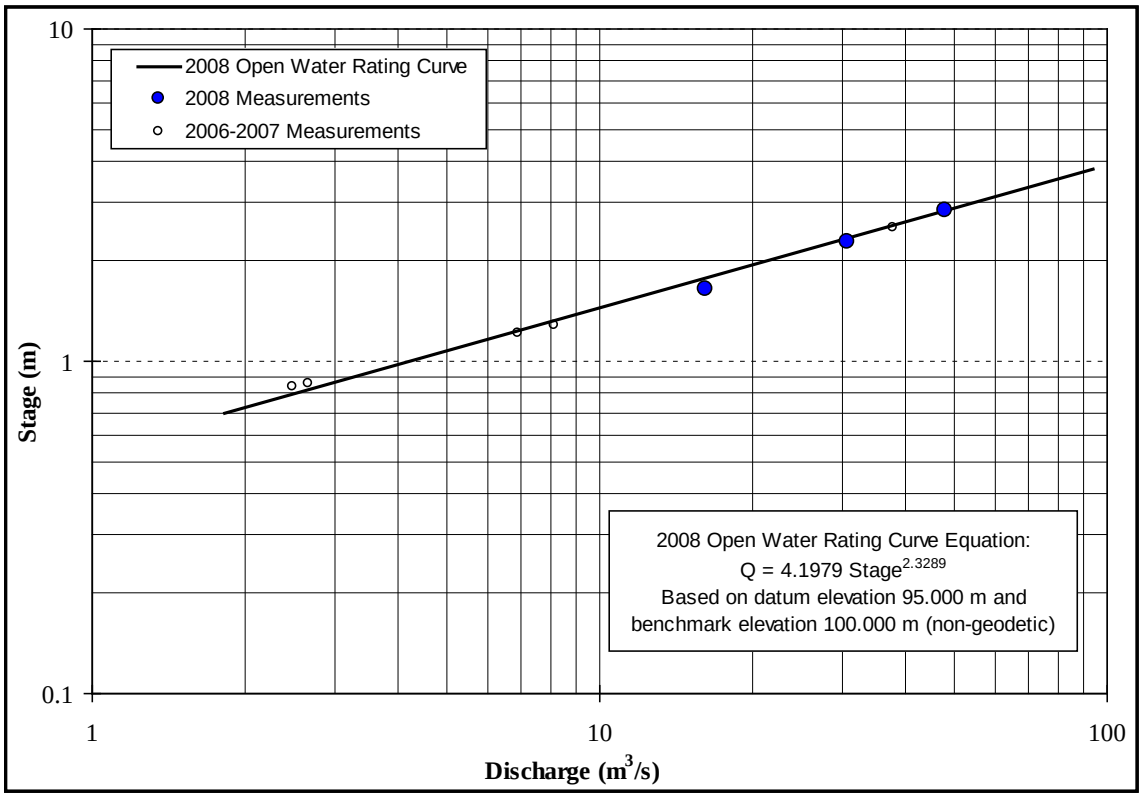
Station H84 left bank of outlet channel, looking downstream (north).



Station H84 pipe stem and datalogger.




NTS Mapping of Area.




**Aimaokatalok Outflow Station H84 – Stage-Discharge Rating Curve (2008)**

## Aimaokatalok Outflow Station H84 – Stage-Discharge Data (2008)

**Stage Datum** 95.000 m non-geodetic

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge [a] ($m^3/s$) |
|---|---|---|---|---|---|---|
| 24-Jun-2008 12:50 | 98.812 | 6.041 | 92.771 | | 3.812 | |
| 06-Jul-2008 14:15 | 97.853 | 5.036 | 92.817 | 92.759 | 2.853 | 48.0 |
| 13-Aug-2008 13:30 | 96.653 | 3.931 | 92.722 | | 1.653 | 16.2 |
| 11-Sep-2008 10:30 | 97.289 | 4.549 | 92.740 | | 2.289 | 30.8 |

[a] Discharge measurement with ADCP (see Appendix A4).

## H84 Aimaokatalok Lake and Outflow – 2007

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 40.308 | 8.986 | 7.919 | 3.63 E | - | - |
| 2 | - | - | - | - | - | - | 39.958 | 8.562 | 7.834 | 3.37 E | - | - |
| 3 | - | - | - | - | - | - | 39.167 | 8.154 | 7.732 | 3.11 E | - | - |
| 4 | - | - | - | - | - | - | 37.993 | 7.768 | 7.665 | 2.85 E | - | - |
| 5 | - | - | - | - | - | - | 36.667 | 7.428 | 7.593 | 2.59 E | - | - |
| 6 | - | - | - | - | - | - | 35.157 | 7.150 | 7.498 | 2.30 E | - | - |
| 7 | - | - | - | - | - | - | 33.605 | 6.879 | 7.399 | 2.01 E | - | - |
| 8 | - | - | - | - | - | - | 32.043 | 6.631 | 7.281 | 1.72 E | - | - |
| 9 | - | - | - | - | - | - | 30.502 | 6.643 | 7.169 | 1.43 E | - | - |
| 10 | - | - | - | - | - | - | 28.997 | 6.672 | 7.00 E | 1.14 E | - | - |
| 11 | - | - | - | - | - | - | 27.559 | 6.688 | 6.87 E | 1.00 E | - | - |
| 12 | - | - | - | - | - | - | 26.159 | 6.813 | 6.74 E | 0.86 E | - | - |
| 13 | - | - | - | - | - | 1.472 | 24.774 | 7.026 | 6.61 E | 0.72 E | - | - |
| 14 | - | - | - | - | - | 1.842 | 23.457 | 7.209 | 6.48 E | 0.58 E | - | - |
| 15 | - | - | - | - | - | 2.367 | 22.186 | 7.417 | 6.35 E | 0.44 E | - | - |
| 16 | - | - | - | - | - | 2.985 | 21.023 | 7.590 | 6.22 E | 0.32 E | - | - |
| 17 | - | - | - | - | - | 3.597 | 19.822 | 7.735 | 6.09 E | 0.21 E | - | - |
| 18 | - | - | - | - | - | 4.439 | 18.679 | 7.845 | 5.96 E | 0.17 E | - | - |
| 19 | - | - | - | - | - | 5.599 | 17.638 | 8.007 | 5.83 E | 0.13 E | - | - |
| 20 | - | - | - | - | - | 7.051 | 16.744 | 8.164 | 5.70 E | 0.10 E | - | - |
| 21 | - | - | - | - | - | 9.255 | 15.928 | 8.257 | 5.57 E | 0.07 E | - | - |
| 22 | - | - | - | - | - | 12.577 | 15.040 | 8.310 | 5.44 E | 0.04 E | - | - |
| 23 | - | - | - | - | - | 16.672 | 14.268 | 8.330 | 5.27 E | - | - | - |
| 24 | - | - | - | - | - | 21.391 | 13.558 | 8.319 | 5.10 E | - | - | - |
| 25 | - | - | - | - | - | 26.060 | 12.866 | 8.288 | 4.93 E | - | - | - |
| 26 | - | - | - | - | - | 30.458 | 12.206 | 8.240 | 4.76 E | - | - | - |
| 27 | - | - | - | - | - | 34.308 | 11.576 | 8.160 | 4.59 E | - | - | - |
| 28 | - | - | - | - | - | 37.153 | 10.998 | 8.128 | 4.35 E | - | - | - |
| 29 | - | - | - | - | - | 39.032 | 10.456 | 8.107 | 4.11 E | - | - | - |
| 30 | - | - | - | - | - | 40.065 | 9.954 | 8.056 | 3.87 E | - | - | - |
| 31 | - | - | - | - | - | - | 9.477 | 7.992 | - | - | - | - |
| MIN | - | - | - | - | - | 1.472 | 9.477 | 6.631 | 3.870 | 0.042 | - | - |
| MEAN | - | - | - | - | - | 16.462 | 22.863 | 7.728 | 6.198 | 1.309 | - | - |
| MAX | - | - | - | - | - | 40.065 | 40.308 | 8.986 | 7.919 | 3.630 | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 95.657 | 95.624 | 95.605 | 95.585 | 95.588 | 95.576 | 97.564 | 96.346 | 96.275 | 96.045 | 95.896 | 95.734 |
| 2 | 95.656 | 95.624 | 95.606 | 95.585 | 95.588 | 95.575 | 97.555 | 96.318 | 96.269 | 96.037 | 95.889 | 95.731 |
| 3 | 95.656 | 95.623 | 95.607 | 95.584 | 95.587 | 95.574 | 97.533 | 96.291 | 96.262 | 96.030 | 95.884 | 95.727 |
| 4 | 95.655 | 95.622 | 95.607 | 95.582 | 95.587 | 95.574 | 97.500 | 96.264 | 96.257 | 96.026 | 95.876 | 95.725 |
| 5 | 95.655 | 95.621 | 95.605 | 95.582 | 95.587 | 95.573 | 97.462 | 96.240 | 96.252 | 96.018 | 95.870 | 95.716 |
| 6 | 95.654 | 95.621 | 95.603 | 95.581 | 95.586 | 95.571 | 97.418 | 96.220 | 96.245 | 96.012 | 95.863 | 95.713 |
| 7 | 95.653 | 95.619 | 95.602 | 95.579 | 95.589 | 95.572 | 97.371 | 96.200 | 96.238 | 96.008 | 95.856 | 95.710 |
| 8 | 95.652 | 95.617 | 95.604 | 95.580 | 95.588 | 95.574 | 97.323 | 96.181 | 96.230 | 96.005 | 95.850 | 95.707 |
| 9 | 95.651 | 95.617 | 95.604 | 95.581 | 95.588 | 95.574 | 97.275 | 96.182 | 96.222 | 96.003 | 95.844 | 95.705 |
| 10 | 95.650 | 95.615 | 95.605 | 95.582 | 95.587 | 95.575 | 97.226 | 96.184 | 96.212 | 95.998 | 95.837 | 95.702 |
| 11 | 95.648 | 95.616 | 95.604 | 95.581 | 95.586 | 95.578 | 97.178 | 96.186 | 96.205 | 95.993 | 95.830 | 95.699 |
| 12 | 95.648 | 95.615 | 95.601 | 95.581 | 95.585 | 95.590 | 97.130 | 96.195 | 96.197 | 95.986 | 95.823 | 95.697 |
| 13 | 95.647 | 95.613 | 95.601 | 95.582 | 95.585 | 95.619 | 97.080 | 96.211 | 96.190 | 95.980 | 95.817 | 95.693 |
| 14 | 95.644 | 95.612 | 95.601 | 95.582 | 95.585 | 95.681 | 97.032 | 96.225 | 96.180 | 95.976 | 95.811 | 95.692 |
| 15 | 95.643 | 95.611 | 95.600 | 95.582 | 95.587 | 95.759 | 96.984 | 96.240 | 96.173 | 95.970 | 95.805 | 95.689 |
| 16 | 95.642 | 95.612 | 95.596 | 95.581 | 95.587 | 95.838 | 96.939 | 96.252 | 96.164 | 95.964 | 95.800 | 95.686 |
| 17 | 95.641 | 95.611 | 95.595 | 95.580 | 95.585 | 95.908 | 96.890 | 96.262 | 96.154 | 95.959 | 95.794 | 95.684 |
| 18 | 95.639 | 95.610 | 95.595 | 95.580 | 95.586 | 95.994 | 96.843 | 96.270 | 96.144 | 95.953 | 95.789 | 95.681 |
| 19 | 95.638 | 95.609 | 95.595 | 95.579 | 95.584 | 96.098 | 96.798 | 96.281 | 96.136 | 95.949 | 95.784 | 95.681 |
| 20 | 95.637 | 95.608 | 95.594 | 95.578 | 95.583 | 96.212 | 96.758 | 96.292 | 96.129 | 95.946 | 95.779 | 95.680 |
| 21 | 95.636 | 95.608 | 95.592 | 95.578 | 95.582 | 96.362 | 96.721 | 96.298 | 96.119 | 95.944 | 95.774 | 95.680 |
| 22 | 95.634 | 95.607 | 95.592 | 95.578 | 95.581 | 96.554 | 96.679 | 96.302 | 96.112 | 95.941 | 95.770 | 95.677 |
| 23 | 95.634 | 95.606 | 95.591 | 95.578 | 95.581 | 96.754 | 96.642 | 96.303 | 96.106 | 95.941 | 95.765 | 95.678 |
| 24 | 95.633 | 95.605 | 95.589 | 95.577 | 95.580 | 96.952 | 96.606 | 96.302 | 96.100 | 95.937 | 95.761 | 95.677 |
| 25 | 95.631 | 95.605 | 95.589 | 95.578 | 95.579 | 97.126 | 96.570 | 96.300 | 96.093 | 95.933 | 95.758 | 95.675 |
| 26 | 95.630 | 95.604 | 95.588 | 95.584 | 95.579 | 97.273 | 96.535 | 96.297 | 96.085 | 95.928 | 95.754 | 95.672 |
| 27 | 95.629 | 95.604 | 95.588 | 95.588 | 95.579 | 97.392 | 96.501 | 96.291 | 96.076 | 95.924 | 95.749 | 95.670 |
| 28 | 95.628 | 95.604 | 95.587 | 95.588 | 95.578 | 97.476 | 96.468 | 96.289 | 96.069 | 95.919 | 95.744 | 95.669 |
| 29 | 95.627 | - | 95.587 | 95.587 | 95.578 | 97.529 | 96.436 | 96.288 | 96.060 | 95.915 | 95.741 | 95.666 |
| 30 | 95.626 | - | 95.586 | 95.587 | 95.577 | 97.557 | 96.406 | 96.284 | 96.052 | 95.909 | 95.737 | 95.665 |
| 31 | 95.625 | - | 95.585 | - | 95.577 | - | 96.377 | 96.280 | 96.045 | 95.902 | 95.734 | 95.664 |
| MIN | 95.625 | 95.604 | 95.585 | 95.577 | 95.577 | 95.571 | 96.377 | 96.181 | 96.045 | 95.902 | 95.734 | 95.664 |
| MEAN | 95.642 | 95.613 | 95.597 | 95.582 | 95.584 | 96.166 | 96.961 | 96.260 | 96.127 | 95.969 | 95.806 | 95.692 |
| MAX | 95.657 | 95.624 | 95.607 | 95.588 | 95.589 | 97.557 | 97.564 | 96.346 | 96.212 | 96.045 | 95.896 | 95.734 |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

## H84 Aimaokatalok Lake and Outflow – 2008

**MEAN DAILY DISCHARGES ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | 2.29 E | 66.56 | 17.38 | 19.74 | 11.70 E | - | - |
| 2 | - | - | - | - | - | 2.31 E | 61.83 | 17.16 | 21.88 | 10.78 E | - | - |
| 3 | - | - | - | - | - | 2.40 E | 57.42 | 16.86 | 23.95 | 9.91 E | - | - |
| 4 | - | - | - | - | - | 2.45 E | 53.41 | 16.57 | 25.75 | 9.19 E | - | - |
| 5 | - | - | - | - | - | 2.50 E | 49.69 | 16.18 | 27.26 | 8.47 E | - | - |
| 6 | - | - | - | - | - | 2.61 E | 46.3 | 15.88 | 28.36 | 7.75 E | - | - |
| 7 | - | - | - | - | - | 2.97 P | 43.18 | 15.53 | 29.04 | 7.03 E | - | - |
| 8 | - | - | - | - | - | 3.57 | 40.36 | 15.21 | 29.44 | 6.31 E | - | - |
| 9 | - | - | - | - | - | 4.55 | 37.77 | 14.84 | 29.62 | 5.59 E | - | - |
| 10 | - | - | - | - | - | 5.8 | 35.36 | 14.51 | 29.64 | 4.90 E | - | - |
| 11 | - | - | - | - | - | 6.83 | 33.15 | 14.28 | 29.51 P | 4.25 E | - | - |
| 12 | - | - | - | - | - | 7.91 | 31.14 | 14.27 | 29.28 E | 3.75 E | - | - |
| 13 | - | - | - | - | - | 9.55 | 29.41 | 14.27 | 29.10 E | 3.25 E | - | - |
| 14 | - | - | - | - | - | 11.78 | 27.77 | 14.27 | 28.71 E | 2.75 E | - | - |
| 15 | - | - | - | - | - | 14.75 | 26.18 | 14.35 | 28.28 E | 2.35 E | - | - |
| 16 | - | - | - | - | - | 20.05 | 24.68 | 14.51 | 27.85 E | 1.95 E | - | - |
| 17 | - | - | - | - | - | 27.98 | 23.29 | 14.66 | 27.41 E | 1.55 E | - | - |
| 18 | - | - | - | - | - | 38.14 | 22.03 | 14.85 | 26.83 E | 1.25 E | - | - |
| 19 | - | - | - | - | - | 50.98 | 21.01 | 14.93 | 26.06 E | 0.95 E | - | - |
| 20 | - | - | - | - | - | 65.31 | 19.88 | 14.96 | 25.23 E | 0.75 E | - | - |
| 21 | - | - | - | - | - | 82.55 | 18.84 | 15.01 | 24.32 E | 0.55 E | - | - |
| 22 | - | - | - | - | 0.25 E | 95.6 | 18.04 | 15.06 | 23.49 E | 0.35 E | - | - |
| 23 | - | - | - | - | 0.45 E | 99.7 | 17.46 | 15.16 | 22.19 E | 0.15 E | - | - |
| 24 | - | - | - | - | 0.70 E | 94.4 | 16.84 | 15.2 | 20.84 E | 0.07 E | - | - |
| 25 | - | - | - | - | 0.95 E | 93.3 | 16.38 | 15.22 | 19.24 E | - | - | - |
| 26 | - | - | - | - | 1.15 E | 90.33 | 16.82 | 15.15 | 18.08 E | - | - | - |
| 27 | - | - | - | - | 1.45 E | 87.69 | 17.21 | 15.18 | 16.73 E | - | - | - |
| 28 | - | - | - | - | 1.85 E | 82.16 | 17.4 | 15.33 | 15.47 E | - | - | - |
| 29 | - | - | - | - | 1.95 E | 76.75 | 17.51 | 15.76 | 14.07 E | - | - | - |
| 30 | - | - | - | - | 2.05 E | 71.51 | 17.53 | 16.67 | 12.81 E | - | - | - |
| 31 | - | - | - | - | 2.15 E | 66.56 | 17.48 | 18.01 | - | - | - | - |
| MIN | - | - | - | - | 0.25 | 2.288 | 16.384 | 14.269 | 12.81 | 0.07 | - | - |
| MEAN | - | - | - | - | 1.295 | 39.527 | 30.385 | 15.394 | 24.339 | 4.398 | - | - |
| MAX | - | - | - | - | 2.15 | 99.738 | 66.558 | 18.014 | 29.636 | 11.7 | - | - |

MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK EL. 100.000 m **(NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 95.828 | 95.792 | 95.762 | 95.744 | 95.738 | 95.771 | 98.276 | 96.840 | 96.944 | - | - | - |
| 2 | 95.825 | 95.791 | 95.762 | 95.744 | 95.737 | 95.773 | 98.174 | 96.831 | 97.032 | - | - | - |
| 3 | 95.823 | 95.790 | 95.760 | 95.743 | 95.737 | 95.787 | 98.075 | 96.816 | 97.112 | - | - | - |
| 4 | 95.822 | 95.789 | 95.760 | 95.742 | 95.736 | 95.793 | 97.980 | 96.803 | 97.179 | - | - | - |
| 5 | 95.819 | 95.787 | 95.758 | 95.741 | 95.735 | 95.800 | 97.889 | 96.785 | 97.233 | - | - | - |
| 6 | 95.818 | 95.785 | 95.757 | 95.740 | 95.735 | 95.815 | 97.803 | 96.771 | 97.271 | - | - | - |
| 7 | 95.818 | 95.784 | 95.758 | 95.739 | 95.734 | 95.862 | 97.720 | 96.754 | 97.294 | - | - | - |
| 8 | 95.817 | 95.785 | 95.757 | 95.738 | 95.733 | 95.932 | 97.643 | 96.738 | 97.308 | - | - | - |
| 9 | 95.816 | 95.784 | 95.759 | 95.737 | 95.733 | 96.035 | 97.569 | 96.720 | 97.314 | - | - | - |
| 10 | 95.815 | 95.781 | 95.759 | 95.736 | 95.731 | 96.149 | 97.497 | 96.703 | 97.314 | - | - | - |
| 11 | 95.813 | 95.780 | 95.759 | 95.736 | 95.731 | 96.232 | 97.429 | 96.692 | 97.310 P | - | - | - |
| 12 | 95.811 | 95.778 | 95.759 | 95.735 | 95.730 | 96.312 | 97.364 | 96.691 | - | - | - | - |
| 13 | 95.809 | 95.778 | 95.758 | 95.734 | 95.730 | 96.423 | 97.307 | 96.691 | - | - | - | - |
| 14 | 95.810 | 95.777 | 95.757 | 95.742 | 95.729 | 96.557 | 97.251 | 96.691 | - | - | - | - |
| 15 | 95.809 | 95.775 | 95.756 | 95.747 | 95.729 | 96.714 | 97.194 | 96.695 | - | - | - | - |
| 16 | 95.807 | 95.774 | 95.756 | 95.748 | 95.728 | 96.955 | 97.140 | 96.703 | - | - | - | - |
| 17 | 95.805 | 95.773 | 95.756 | 95.747 | 95.727 | 97.256 | 97.087 | 96.711 | - | - | - | - |
| 18 | 95.805 | 95.772 | 95.755 | 95.746 | 95.728 | 97.577 | 97.038 | 96.720 | - | - | - | - |
| 19 | 95.803 | 95.771 | 95.754 | 95.745 | 95.732 | 97.919 | 96.997 | 96.724 | - | - | - | - |
| 20 | 95.802 | 95.769 | 95.752 | 95.744 | 95.733 | 98.247 | 96.950 | 96.726 | - | - | - | - |
| 21 | 95.800 | 95.768 | 95.751 | 95.744 | 95.732 | 98.592 | 96.905 | 96.728 | - | - | - | - |
| 22 | 95.798 | 95.768 | 95.751 | 95.743 | 95.731 | 98.827 | 96.870 | 96.731 | - | - | - | - |
| 23 | 95.797 | 95.767 | 95.750 | 95.743 | 95.731 | 98.897 | 96.844 | 96.735 | - | - | - | - |
| 24 | 95.796 | 95.766 | 95.749 | 95.744 | 95.730 | 98.806 | 96.816 | 96.737 | - | - | - | - |
| 25 | 95.795 | 95.764 | 95.748 | 95.744 | 95.730 | 98.787 | 96.794 | 96.738 | - | - | - | - |
| 26 | 95.794 | 95.764 | 95.748 | 95.743 | 95.730 | 98.735 | 96.815 | 96.735 | - | - | - | - |
| 27 | 95.794 | 95.763 | 95.746 | 95.742 | 95.731 | 98.688 | 96.833 | 96.737 | - | - | - | - |
| 28 | 95.795 | 95.762 | 95.745 | 95.741 | 95.733 | 98.586 | 96.841 | 96.744 | - | - | - | - |
| 29 | 95.794 | 95.762 | 95.745 | 95.740 | 95.739 | 98.483 | 96.846 | 96.765 | - | - | - | - |
| 30 | 95.794 | 95.762 | 95.745 | 95.739 | 95.753 | 98.378 | 96.847 | 96.808 | - | - | - | - |
| 31 | 95.792 | 95.762 | 95.744 | 95.738 | 95.767 | 98.276 | 96.845 | 96.869 | - | - | - | - |
| MIN | 95.792 | 95.762 | 95.744 | 95.734 | 95.727 | 95.771 | 96.794 | 96.691 | 96.944 | - | - | - |
| MEAN | 95.807 | 95.775 | 95.754 | 95.742 | 95.734 | 97.225 | 97.279 | 96.746 | 97.210 | - | - | - |
| MAX | 95.828 | 95.792 | 95.762 | 95.748 | 95.767 | 98.897 | 98.276 | 96.869 | 97.314 | - | - | - |

NOTES: D – DERIVED BASED ON DOWNSTREAM DISCHARGES E – ESTIMATED P – PARTIAL DAILY AVERAGE

# FICKLE DUCK LAKE AND OUTFLOW HYDROMETRIC STATION

**H86**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located approximately 80 m upstream of outflow, on the right downstream bank of Fickle Duck Lake in the floodplain. Datalogger installed on tripod to prevent flood damage.

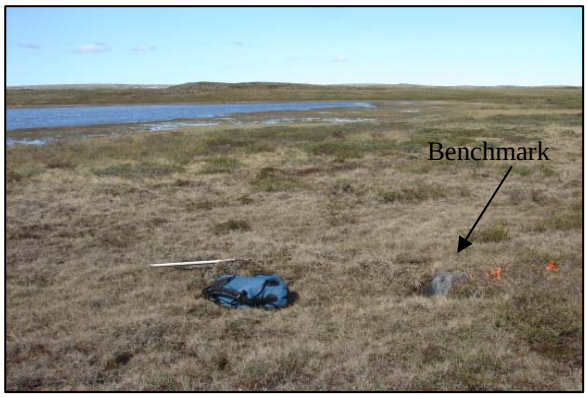
| Operational: | 2006<br>2/6-10/9 | 2007<br>26/5-9/9 | 2008<br>26/6-11/9 | 2009 |
|---|---|---|---|---|

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 31.3 km$^2$

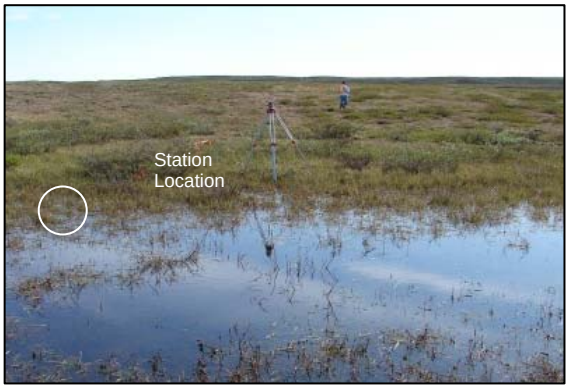
Coordinates: UTM: 442699 m E, 7503688 m N (Zone 13W NAD83) Lat/Long: 67°38'35" N, 106°21'00" W

Instruments: Optimum Instruments Datalogger, Keller Transducer

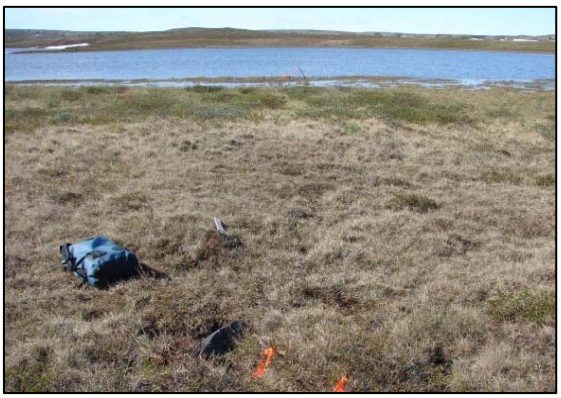
Station H86 looking northwest (downstream) during spring flood.



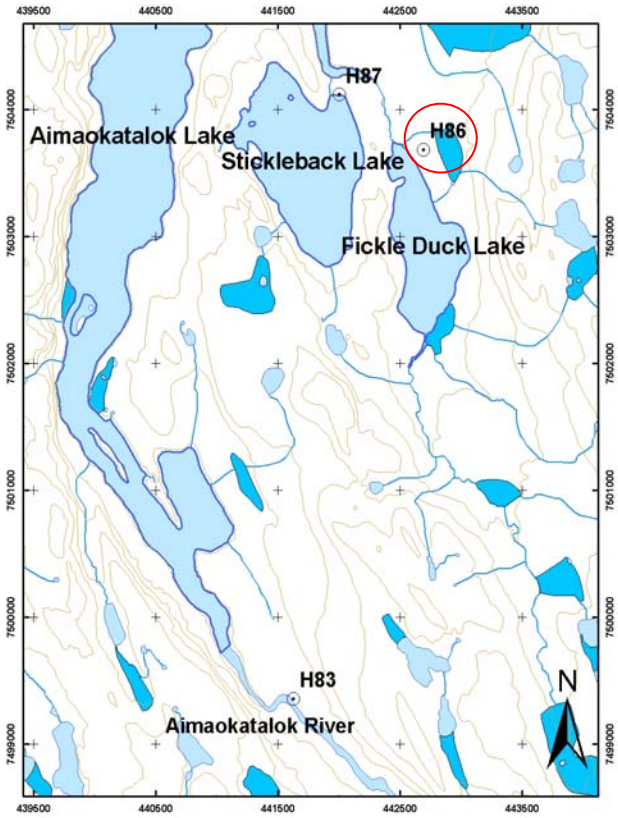

Station H86 looking north to outlet channel.




Station H86 looking east during July 2008.

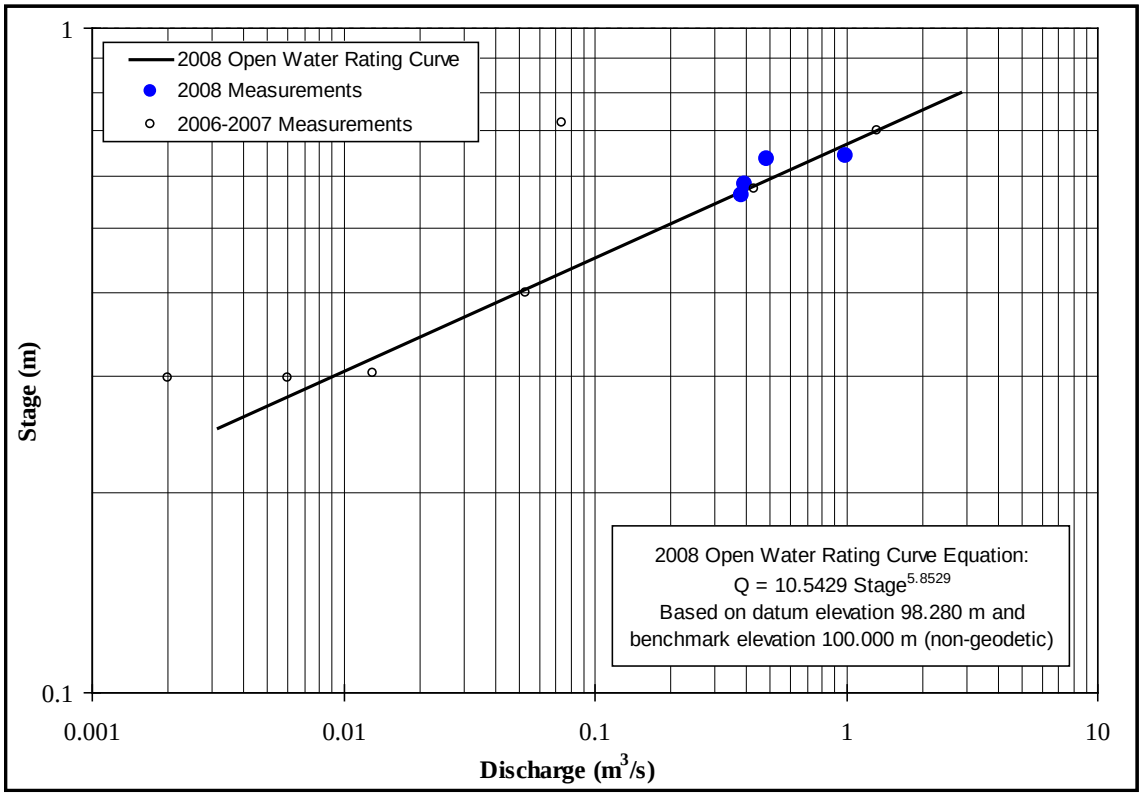


Station H86 looking west during July 2008.




NTS Mapping of Area.

FACT-H86-2008.DOC




**Fickle Duck Outflow Station H86 – Stage-Discharge Rating Curve (2008)**

## Fickle Duck Outflow Station H86 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 26-Jun-2008 08:55 | 98.922 | - | - | 98.046 | 0.642 | 0.996 |
| 05-Jul-2008 10:02 | 98.841 | - | - | | 0.561 | 0.383 |
| 11-Aug-2008 14:40 | 98.864 | 0.804 | 98.060 | | 0.584 | 0.393 |
| 11-Sep-2008 12:40 | 98.916 | 0.884 | 98.032 | | 0.636 | 0.484 |

## H86 Fickle Duck Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | - | 1.405 | - | - | - |
| 2 | - | - | - | - | - | - | - | - | 1.433 | - | - | - |
| 3 | - | - | - | - | - | - | - | - | 1.190 | - | - | - |
| 4 | - | - | - | - | - | - | - | - | 0.966 | - | - | - |
| 5 | - | - | - | - | - | - | 0.383 A | - | 0.811 | - | - | - |
| 6 | - | - | - | - | - | - | - | - | 0.701 | - | - | - |
| 7 | - | - | - | - | - | - | - | - | 0.611 | - | - | - |
| 8 | - | - | - | - | - | - | - | - | 0.554 | - | - | - |
| 9 | - | - | - | - | - | - | - | - | 0.525 | - | - | - |
| 10 | - | - | - | - | - | - | - | - | 0.505 | - | - | - |
| 11 | - | - | - | - | - | - | - | 0.398 P | 0.491 P | - | - | - |
| 12 | - | - | - | - | - | - | - | 0.497 | 0.480 E | - | - | - |
| 13 | - | - | - | - | - | - | - | 0.650 | 0.466 E | - | - | - |
| 14 | - | - | - | - | - | - | - | 0.723 | 0.452 E | - | - | - |
| 15 | - | - | - | - | - | - | - | 0.817 | 0.435 E | - | - | - |
| 16 | - | - | - | - | - | - | - | 0.835 | 0.417 E | - | - | - |
| 17 | - | - | - | - | - | - | - | 0.779 | 0.403 E | - | - | - |
| 18 | - | - | - | - | - | - | - | 0.716 | 0.381 E | - | - | - |
| 19 | - | - | - | - | - | - | - | 0.640 | 0.359 E | - | - | - |
| 20 | - | - | - | - | - | - | - | 0.579 | 0.337 E | - | - | - |
| 21 | - | - | - | - | - | - | - | 0.525 | 0.315 E | - | - | - |
| 22 | - | - | - | - | - | - | - | 0.480 | 0.296 E | - | - | - |
| 23 | - | - | - | - | - | - | - | 0.453 | 0.277 E | - | - | - |
| 24 | - | - | - | - | - | - | - | 0.436 | 0.258 E | - | - | - |
| 25 | - | - | - | - | - | - | - | 0.415 | 0.239 E | - | - | - |
| 26 | - | - | - | - | - | 0.996 A | - | 0.395 | 0.220 E | - | - | - |
| 27 | - | - | - | - | - | - | - | 0.462 | 0.201 E | - | - | - |
| 28 | - | - | - | - | - | - | - | 0.530 | 0.182 E | - | - | - |
| 29 | - | - | - | - | - | - | - | 0.708 | 0.163 E | - | - | - |
| 30 | - | - | - | - | - | - | - | 1.022 | 0.144 E | - | - | - |
| 31 | - | - | - | - | - | - | - | 1.269 | - | - | - | - |
| MIN | - | - | - | - | - | - | - | 0.395 | 0.144 | - | - | - |
| MEAN | - | - | - | - | - | - | - | 0.635 | 0.507 | - | - | - |
| MAX | - | - | - | - | - | - | - | 1.269 | 1.433 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | - | 98.988 | - | - | - |
| 2 | - | - | - | - | - | - | - | - | 98.991 | - | - | - |
| 3 | - | - | - | - | - | - | - | - | 98.969 | - | - | - |
| 4 | - | - | - | - | - | - | - | - | 98.945 | - | - | - |
| 5 | - | - | - | - | - | | | | 98.925 | - | - | - |
| 6 | - | - | - | - | - | - | - | - | 98.909 | - | - | - |
| 7 | - | - | - | - | - | - | - | - | 98.895 | - | - | - |
| 8 | - | - | - | - | - | - | - | - | 98.884 | - | - | - |
| 9 | - | - | - | - | - | - | - | - | 98.879 | - | - | - |
| 10 | - | - | - | - | - | - | - | - | 98.875 | - | - | - |
| 11 | - | - | - | - | - | - | - | 98.851 P | 98.872 P | - | - | - |
| 12 | - | - | - | - | - | - | - | 98.873 | - | - | - | - |
| 13 | - | - | - | - | - | - | - | 98.901 | - | - | - | - |
| 14 | - | - | - | - | - | - | - | 98.913 | - | - | - | - |
| 15 | - | - | - | - | - | - | - | 98.926 | - | - | - | - |
| 16 | - | - | - | - | - | - | - | 98.928 | - | - | - | - |
| 17 | - | - | - | - | - | - | - | 98.921 | - | - | - | - |
| 18 | - | - | - | - | - | - | - | 98.912 | - | - | - | - |
| 19 | - | - | - | - | - | - | - | 98.900 | - | - | - | - |
| 20 | - | - | - | - | - | - | - | 98.889 | - | - | - | - |
| 21 | - | - | - | - | - | - | - | 98.879 | - | - | - | - |
| 22 | - | - | - | - | - | - | - | 98.870 | - | - | - | - |
| 23 | - | - | - | - | - | - | - | 98.864 | - | - | - | - |
| 24 | - | - | - | - | - | - | - | 98.860 | - | - | - | - |
| 25 | - | - | - | - | - | - | - | 98.855 | - | - | - | - |
| 26 | - | - | - | - | - | - | - | 98.851 | - | - | - | - |
| 27 | - | - | - | - | - | - | - | 98.866 | - | - | - | - |
| 28 | - | - | - | - | - | - | - | 98.880 | - | - | - | - |
| 29 | - | - | - | - | - | - | - | 98.910 | - | - | - | - |
| 30 | - | - | - | - | - | - | - | 98.951 | - | - | - | - |
| 31 | - | - | - | - | - | - | - | 98.976 | - | - | - | - |
| MIN | - | - | - | - | - | - | - | 98.851 | 98.872 | - | - | - |
| MEAN | - | - | - | - | - | - | - | 98.894 | 98.921 | - | - | - |
| MAX | - | - | - | - | - | - | - | 98.976 | 98.991 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED A – Manual Measurements

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Fickle Duck Outflow

LOCATION: Outlet of Fickle Duck Lake

COORDINATES: 442699 m E, 7503688 m N (NAD83)

MEASUREMENT DATE: 26 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 9:10 h

MEASUREMENT END TIME: 9:35 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | 0.03 | | | 0.00 | 0.000 |
| 2 | 1.0 | 0.09 | | | 0.00 | 0.000 |
| 3 | 2.0 | 0.10 | | | 0.00 | 0.000 |
| 4 | 3.0 | 0.19 | | | 0.03 | 0.006 |
| 5 | 4.0 | 0.32 | | | 0.16 | 0.038 |
| 6 | 4.5 | 0.38 | | | 0.40 | 0.076 |
| 7 | 5.0 | 0.38 | | | 0.64 | 0.122 |
| 8 | 5.5 | 0.42 | | | 0.70 | 0.147 |
| 9 | 6.0 | 0.56 | | | 0.54 | 0.151 |
| 10 | 6.5 | 0.56 | | | 0.45 | 0.126 |
| 11 | 7.0 | 0.41 | | | 0.31 | 0.064 |
| 12 | 7.5 | 0.41 | | | 0.08 | 0.016 |
| 13 | 8.0 | 0.44 | | | 0.15 | 0.050 |
| 14 | 9.0 | 0.32 | | | 0.09 | 0.029 |
| 15 | 10.0 | 0.32 | | | 0.18 | 0.058 |
| 16 | 11.0 | 0.32 | | | 0.10 | 0.032 |
| 17 | 12.0 | 0.30 | | | 0.10 | 0.030 |
| 18 | 13.0 | 0.26 | | | 0.05 | 0.013 |
| 19 | 14.0 | 0.28 | | | 0.07 | 0.020 |
| 20 | 15.0 | 0.30 | | | 0.02 | 0.006 |
| 21 | 16.0 | 0.23 | | | 0.06 | 0.014 |
| 22 | 17.0 | 0.08 | | | 0.00 | 0.000 |
| 23 | 18.0 | 0.12 | | | 0.00 | 0.000 |
| 24 | 19.0 | 0.06 | | | 0.00 | 0.000 |
| Left Bank | 19.2 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.996** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Fickle Duck Outflow

LOCATION: Outlet of Fickle Duck Lake

COORDINATES: 442699 m E, 7503688 m N (NAD83)

MEASUREMENT DATE: 5 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 8:45 h

MEASUREMENT END TIME: 9:15 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 14.2 | 0.00 | | | 0.00 | 0.000 |
| 2 | 13.9 | 0.11 | | | 0.18 | 0.006 |
| 3 | 13.6 | 0.16 | | | 0.27 | 0.013 |
| 4 | 13.3 | 0.17 | | | 0.36 | 0.018 |
| 5 | 13.0 | 0.20 | | | 0.44 | 0.026 |
| 6 | 12.7 | 0.22 | | | 0.34 | 0.019 |
| 7 | 12.5 | 0.20 | | | 0.35 | 0.014 |
| 8 | 12.3 | 0.12 | | | 0.33 | 0.010 |
| 9 | 12.0 | 0.16 | | | 0.16 | 0.008 |
| 10 | 11.7 | 0.16 | | | 0.22 | 0.011 |
| 11 | 11.4 | 0.10 | | | 0.11 | 0.003 |
| 12 | 11.1 | 0.12 | | | 0.12 | 0.004 |
| 13 | 10.8 | 0.16 | | | 0.14 | 0.007 |
| 14 | 10.5 | 0.10 | | | 0.24 | 0.010 |
| 15 | 10.0 | 0.14 | | | 0.16 | 0.011 |
| 16 | 9.5 | 0.80 | | | 0.44 | 0.176 |
| 17 | 9.0 | 0.14 | | | 0.29 | 0.020 |
| 18 | 8.5 | 0.14 | | | 0.10 | 0.007 |
| 19 | 8.0 | 0.12 | | | 0.07 | 0.004 |
| 20 | 7.5 | 0.10 | | | 0.04 | 0.002 |
| 21 | 7.0 | 0.10 | | | 0.06 | 0.005 |
| 22 | 6.0 | 0.10 | | | 0.02 | 0.002 |
| 23 | 5.0 | 0.10 | | | 0.02 | 0.002 |
| 24 | 4.0 | 0.06 | | | 0.01 | 0.001 |
| 25 | 3.0 | 0.08 | | | 0.01 | 0.001 |
| 26 | 2.0 | 0.08 | | | 0.03 | 0.002 |
| 27 | 1.0 | 0.12 | | | 0.02 | 0.001 |
| Right Bank | 0.8 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.383** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Fickle Duck Outflow

LOCATION: Outlet of Fickle Duck Lake

COORDINATES: 442699 m E, 7503688 m N (NAD83)

MEASUREMENT DATE: 11 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:40 h

MEASUREMENT END TIME:12:05 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.0 | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | 0.10 | | | 0.05 | 0.005 |
| 3 | 2.0 | 0.15 | | | 0.05 | 0.011 |
| 4 | 4.0 | 0.20 | | | 0.15 | 0.060 |
| 5 | 6.0 | 0.23 | | | 0.15 | 0.040 |
| 6 | 6.3 | 0.40 | | | 0.52 | 0.042 |
| 7 | 6.4 | 0.42 | | | 0.65 | 0.027 |
| 8 | 6.5 | 0.42 | | | 0.70 | 0.029 |
| 9 | 6.6 | 0.42 | | | 0.68 | 0.029 |
| 10 | 6.7 | 0.44 | | | 0.58 | 0.026 |
| 11 | 6.8 | 0.42 | | | 0.35 | 0.015 |
| 12 | 6.9 | 0.40 | | | 0.30 | 0.012 |
| 13 | 7.0 | 0.34 | | | 0.17 | 0.061 |
| 14 | 9.0 | 0.28 | | | 0.05 | 0.028 |
| 15 | 11.0 | 0.12 | | | 0.05 | 0.009 |
| Right Bank | 12.0 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.393** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Fickle Duck Outflow

LOCATION: Outlet of Fickle Duck Lake

COORDINATES: 442699 m E, 7503688 m N (NAD83)

MEASUREMENT DATE: 11 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / DA

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:25 h

MEASUREMENT END TIME: 13:21 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.1 | 0.12 | | | 0.02 | 0.001 |
| 3 | 0.5 | 0.16 | | | 0.19 | 0.014 |
| 4 | 1.0 | 0.20 | | | 0.16 | 0.013 |
| 5 | 1.3 | 0.32 | | | 0.31 | 0.030 |
| 6 | 1.6 | 0.48 | | | 0.56 | 0.081 |
| 7 | 1.9 | 0.54 | | | 0.76 | 0.123 |
| 8 | 2.2 | 0.50 | | | 0.78 | 0.117 |
| 9 | 2.5 | 0.48 | | | 0.43 | 0.052 |
| 10 | 2.7 | 0.42 | | | 0.44 | 0.037 |
| 11 | 2.9 | 0.21 | | | 0.26 | 0.014 |
| 12 | 3.2 | 0.14 | | | 0.06 | 0.003 |
| 13 | 3.5 | 0.10 | | | 0.01 | 0.000 |
| 14 | 3.8 | 0.16 | | | 0.01 | 0.000 |
| 15 | 4.1 | 0.17 | | | 0.01 | 0.001 |
| 16 | 4.8 | 0.10 | | | 0.00 | 0.000 |
| Left Bank | 5.5 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.484** |

# KOIGNUK RIVER HYDROMETRIC STATION

**H85**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on the right downstream bank of the Koignuk River, upstream of Roberts Bay backwater.

| Operational: | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| | 3/6-10/9 | 26/5-9/9 | 23/6-14/9 | |

Benchmark: Top of embedded boulder, 100.000 m (local) Drainage Area: 3192 km$^2$

Coordinates: UTM: 429739 m E, 7554336 m N (Zone 13W NAD83) Lat/Long: 68°05'39" N, 106°41'16" W

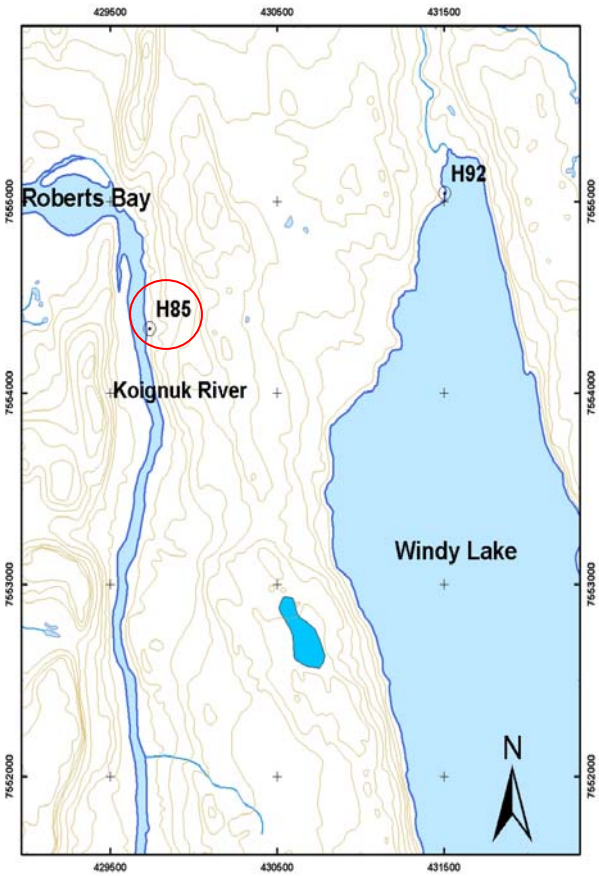
Instruments: Optimum Instruments Datalogger, Keller Transducer

Station H85 looking downstream (north) from the right bank.

Station H85 view from right bank downstream (north).

Station H85 benchmark on the right bank.

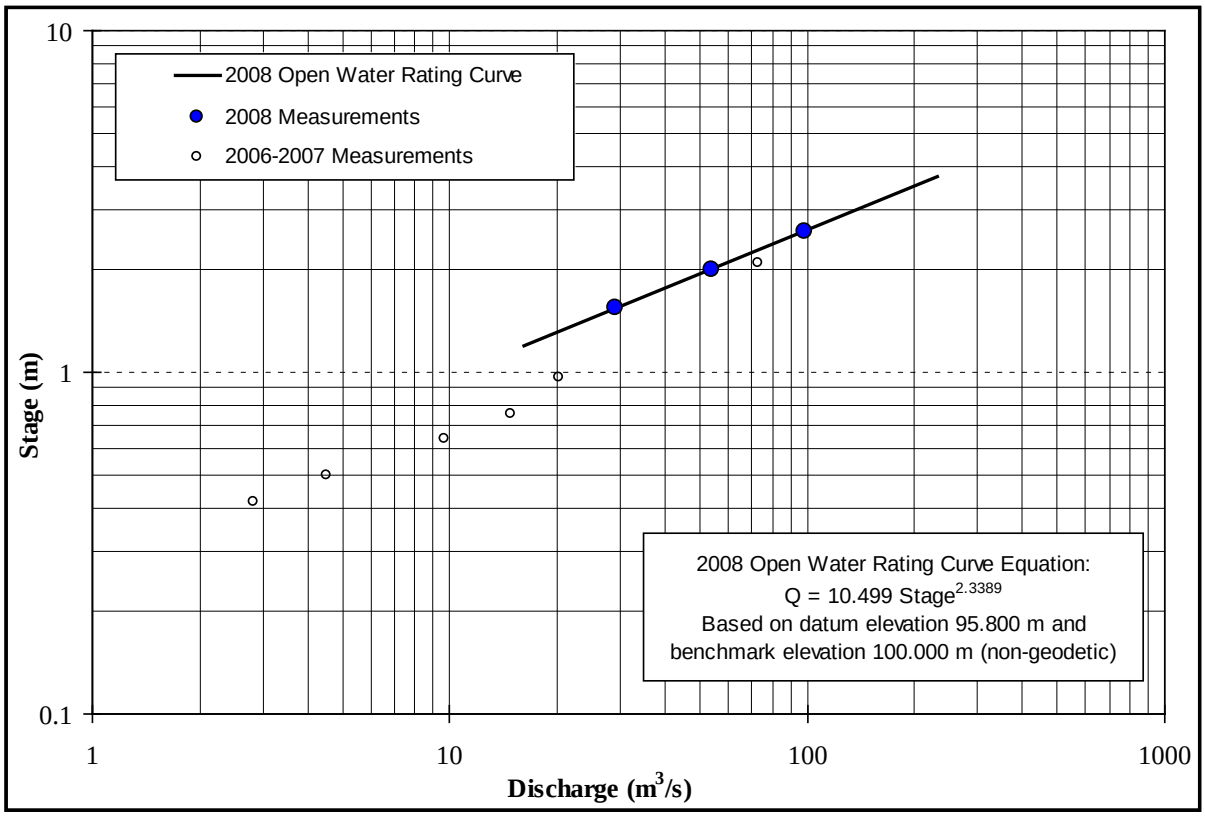
Station H85 looking upstream (south) from the right bank.




NTS Mapping of Area.

FACT-H85-2008.DOC

**Golder Associates**




**Koignuk River Station H85 – Stage-Discharge Rating Curve (2008)**

## Koignuk River Station H85 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation [a] (m) | Average Transducer Elevation (m) | Stage [b] (m) | Measured Discharge [c] ($m^3/s$) |
|---|---|---|---|---|---|---|
| 23-Jun-2008 09:25 | 99.484 | 2.626 | 96.858 | 96.885 | *3.724* | |
| 06-Jul-2008 11:05 | | 1.515 | | | *2.613* | 98.7 |
| 09-Aug-2008 11:00 | 97.351 | 0.467 | 96.884 | | 1.551 | 29.1 |
| 14-Sep-2008 08:25 | 97.802 | 0.890 | 96.912 | | 2.002 | 53.9 |

Note (a) – On 6 July 2008 transducer elevation was not calculated because water level was not surveyed.
(b) – Stage values in italics are computed from transducer's readings.
(c) – Discharge measurement with ADCP (see Appendix A4).

## H85 Koignuk River – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 136.8 | 32.0 | 47.2 | - | - | - |
| 2 | - | - | - | - | - | - | 128.5 | 32.1 | 53.7 | - | - | - |
| 3 | - | - | - | - | - | - | 120.0 | 31.7 | 43.0 | - | - | - |
| 4 | - | - | - | - | - | - | 111.5 | 29.4 | 38.7 | - | - | - |
| 5 | - | - | - | - | - | - | 103.7 | 29.6 | 44.3 | - | - | - |
| 6 | - | - | - | - | - | - | 96.8 | 30.2 | 49.5 | - | - | - |
| 7 | - | - | - | - | - | - | 90.5 | 30.5 | 48.9 | - | - | - |
| 8 | - | - | - | - | - | - | 84.7 | 30.0 | 47.3 | - | - | - |
| 9 | - | - | - | - | - | - | 79.3 | 29.6 | 46.9 | - | - | - |
| 10 | - | - | - | - | - | - | 72.8 | 22.8 | 46.7 | - | - | - |
| 11 | - | - | - | - | - | - | 68.4 | 22.7 | 50.6 | - | - | - |
| 12 | - | - | - | - | - | - | 63.5 | 25.5 | 51.6 | - | - | - |
| 13 | - | - | - | - | - | - | 59.2 | 27.5 | 52.5 | - | - | - |
| 14 | - | - | - | - | - | - | 55.9 | 26.9 | 51.8 P | - | - | - |
| 15 | - | - | - | - | - | - | 51.0 | 26.6 | - | - | - | - |
| 16 | - | - | - | - | - | - | 44.6 | 27.9 | - | - | - | - |
| 17 | - | - | - | - | - | - | 34.7 | 27.7 | - | - | - | - |
| 18 | - | - | - | - | - | - | 39.6 | 28.6 | - | - | - | - |
| 19 | - | - | - | - | - | - | 36.3 | 30.1 | - | - | - | - |
| 20 | - | - | - | - | - | - | 31.2 | 29.3 | - | - | - | - |
| 21 | - | - | - | - | - | - | 32.0 | 28.1 | - | - | - | - |
| 22 | - | - | - | - | - | - | 31.6 | 28.6 | - | - | - | - |
| 23 | - | - | - | - | - | 203.1 P | 33.4 | 27.8 | - | - | - | - |
| 24 | - | - | - | - | - | 200.1 | 31.5 | 28.5 | - | - | - | - |
| 25 | - | - | - | - | - | 193.4 | 34.1 | 28.2 | - | - | - | - |
| 26 | - | - | - | - | - | 185.6 | 31.5 | 26.7 | - | - | - | - |
| 27 | - | - | - | - | - | 176.1 | 34.4 | 26.4 | - | - | - | - |
| 28 | - | - | - | - | - | 164.9 | 34.8 | 26.5 | - | - | - | - |
| 29 | - | - | - | - | - | 154.7 | 35.6 | 26.8 | - | - | - | - |
| 30 | - | - | - | - | - | 144.9 | 34.6 | 32.2 | - | - | - | - |
| 31 | - | - | - | - | - | - | 34.0 | 38.6 | - | - | - | - |
| MIN | - | - | - | - | - | 144.9 | 31.2 | 22.7 | 38.7 | - | - | - |
| MEAN | - | - | - | - | - | 177.8 | 60.5 | 28.7 | 48.1 | - | - | - |
| MAX | - | - | - | - | - | 203.1 | 136.8 | 38.6 | 53.7 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 98.843 | 97.427 | 97.715 | - | - | - |
| 2 | - | - | - | - | - | - | 98.755 | 97.428 | 97.822 | - | - | - |
| 3 | - | - | - | - | - | - | 98.662 | 97.418 | 97.639 | - | - | - |
| 4 | - | - | - | - | - | - | 98.568 | 97.369 | 97.562 | - | - | - |
| 5 | - | - | - | - | - | - | 98.480 | 97.374 | 97.664 | - | - | - |
| 6 | - | - | - | - | - | - | 98.402 | 97.387 | 97.755 | - | - | - |
| 7 | - | - | - | - | - | - | 98.327 | 97.394 | 97.744 | - | - | - |
| 8 | - | - | - | - | - | - | 98.256 | 97.383 | 97.717 | - | - | - |
| 9 | - | - | - | - | - | - | 98.188 | 97.373 | 97.710 | - | - | - |
| 10 | - | - | - | - | - | - | 98.102 | 97.203 | 97.707 | - | - | - |
| 11 | - | - | - | - | - | - | 98.041 | 97.204 | 97.773 | - | - | - |
| 12 | - | - | - | - | - | - | 97.971 | 97.278 | 97.788 | - | - | - |
| 13 | - | - | - | - | - | - | 97.908 | 97.325 | 97.803 | - | - | - |
| 14 | - | - | - | - | - | - | 97.858 | 97.313 | 97.792 P | - | - | - |
| 15 | - | - | - | - | - | - | 97.778 | 97.304 | - | - | - | - |
| 16 | - | - | - | - | - | - | 97.669 | 97.334 | - | - | - | - |
| 17 | - | - | - | - | - | - | 97.478 | 97.331 | - | - | - | - |
| 18 | - | - | - | - | - | - | 97.579 | 97.352 | - | - | - | - |
| 19 | - | - | - | - | - | - | 97.513 | 97.386 | - | - | - | - |
| 20 | - | - | - | - | - | - | 97.400 | 97.367 | - | - | - | - |
| 21 | - | - | - | - | - | - | 97.416 | 97.341 | - | - | - | - |
| 22 | - | - | - | - | - | - | 97.416 | 97.351 | - | - | - | - |
| 23 | - | - | - | - | - | 99.499 P | 97.456 | 97.333 | - | - | - | - |
| 24 | - | - | - | - | - | 99.471 | 97.407 | 97.349 | - | - | - | - |
| 25 | - | - | - | - | - | 99.408 | 97.471 | 97.341 | - | - | - | - |
| 26 | - | - | - | - | - | 99.334 | 97.415 | 97.306 | - | - | - | - |
| 27 | - | - | - | - | - | 99.241 | 97.475 | 97.300 | - | - | - | - |
| 28 | - | - | - | - | - | 99.131 | 97.484 | 97.301 | - | - | - | - |
| 29 | - | - | - | - | - | 99.028 | 97.499 | 97.308 | - | - | - | - |
| 30 | - | - | - | - | - | 98.928 | 97.475 | 97.430 | - | - | - | - |
| 31 | - | - | - | - | - | - | 97.469 | 97.559 | - | - | - | - |
| MIN | - | - | - | - | - | 98.928 | 97.400 | 97.203 | 97.562 | - | - | - |
| MEAN | - | - | - | - | - | 99.255 | 97.863 | 97.351 | 97.728 | - | - | - |
| MAX | - | - | - | - | - | 99.499 | 98.843 | 97.559 | 97.822 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

# STICKLEBACK LAKE AND OUTFLOW HYDROMETRIC STATION

**H87**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located approximately 20 m upstream, on the right downstream bank of the Stickleback Lake outflow. A V-notch weir is located at the outflow.

| Operational: | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| | 3/6-10/9 | 25/5-6/9 | 26/6-11/9 | |

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 2.8 km$^2$

Coordinates: UTM: 442009 m E, 7504121 m N (Zone 13W NAD83) Lat/Long: 67°38'48" N, 106°21'60" W

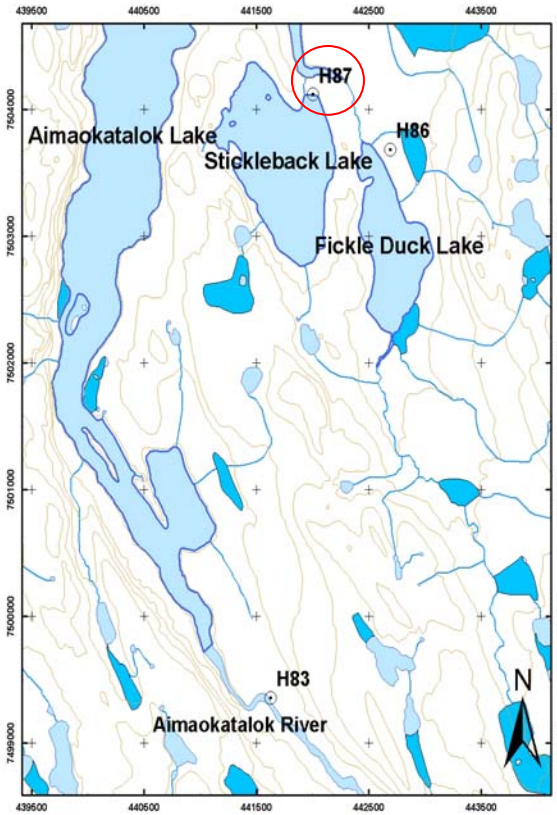
Instruments: Optimum Instruments Datalogger, Keller Transducer

Station H87 weir structure at outlet looking west.

Station H87 looking northwest from east bank.

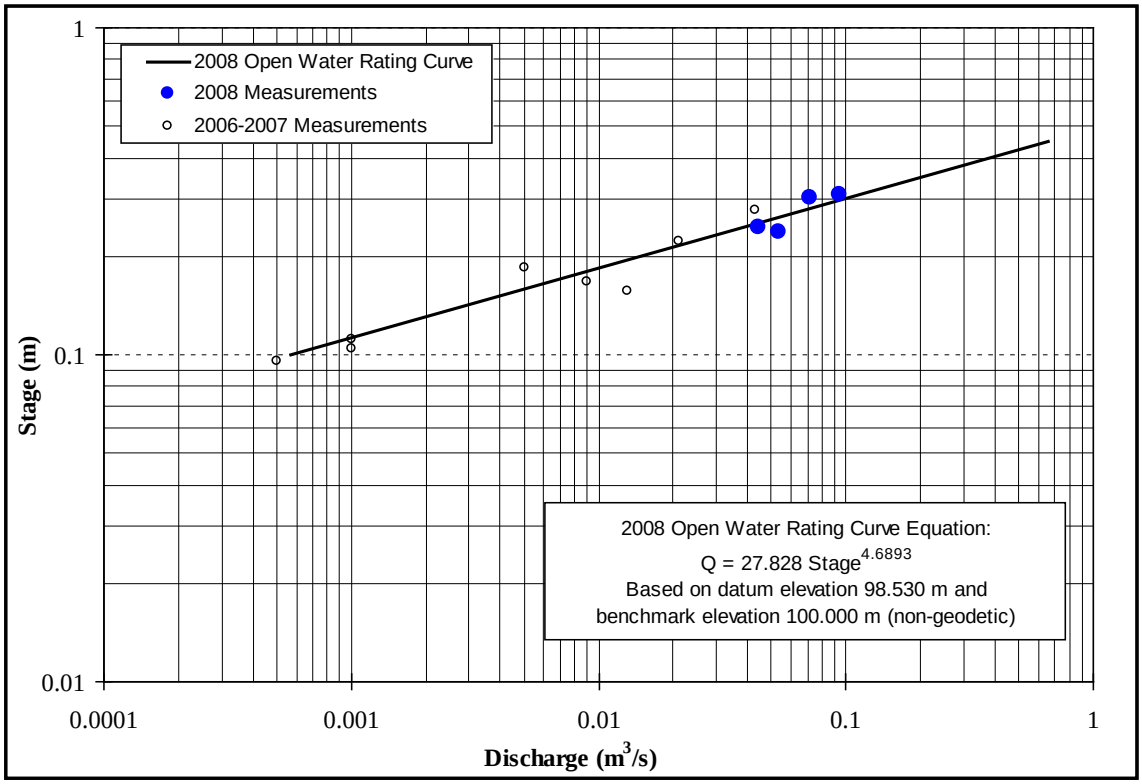
Station H87 V-notch weir structure at outlet.

Station H71 from RDB looking southeast.




NTS Mapping of Area.

FACT-H87-2008.DOC




**Stickleback Outflow Station H87 – Stage-Discharge Rating Curve (2008)**

## Stickleback Outflow Station H87 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 26-Jun-2008 10:45 | 98.836 | 5.009 | 93.827 | 93.855 | 0.311 | 0.093 |
| 05-Jul-2008 10:42 | 98.764 | 4.926 | 93.838 | | 0.239 | 0.054 |
| 11-Aug-2008 12:51 | 98.770 | 4.899 | 93.871 | | 0.245 | 0.044 |
| 11-Sep-2008 13:55 | 98.827 | 4.943 | 93.884 | | 0.302 | 0.071 |

## H87 Stickleback Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 0.122 | 0.201 | 0.189 | - | - | - |
| 2 | - | - | - | - | - | - | 0.092 | 0.107 | 0.340 | - | - | - |
| 3 | - | - | - | - | - | - | 0.070 | 0.069 | 0.364 | - | - | - |
| 4 | - | - | - | - | - | - | 0.055 | 0.066 | 0.315 | - | - | - |
| 5 | - | - | - | - | - | - | 0.041 | 0.056 | 0.252 | - | - | - |
| 6 | - | - | - | - | - | - | 0.034 | 0.057 | 0.186 | - | - | - |
| 7 | - | - | - | - | - | - | 0.030 | 0.037 | 0.139 | - | - | - |
| 8 | - | - | - | - | - | - | 0.024 | 0.026 | 0.115 | - | - | - |
| 9 | - | - | - | - | - | - | 0.023 | 0.023 | 0.098 | - | - | - |
| 10 | - | - | - | - | - | - | 0.025 | 0.021 | 0.086 | - | - | - |
| 11 | - | - | - | - | - | - | 0.024 | 0.033 | 0.067 P | - | - | - |
| 12 | - | - | - | - | - | - | 0.016 | 0.057 | 0.055 E | - | - | - |
| 13 | - | - | - | - | - | - | 0.025 | 0.049 | 0.043 E | - | - | - |
| 14 | - | - | - | - | - | - | 0.032 | 0.044 | 0.031 E | - | - | - |
| 15 | - | - | - | - | - | - | 0.027 | 0.056 | 0.025 E | - | - | - |
| 16 | - | - | - | - | - | - | 0.023 | 0.053 | 0.019 E | - | - | - |
| 17 | - | - | - | - | - | - | 0.024 | 0.044 | 0.013 E | - | - | - |
| 18 | - | - | - | - | - | - | 0.018 | 0.020 | 0.010 E | - | - | - |
| 19 | - | - | - | - | - | - | 0.028 | 0.015 | 0.008 E | - | - | - |
| 20 | - | - | - | - | - | - | 0.040 | 0.007 | 0.006 E | - | - | - |
| 21 | - | - | - | - | - | - | 0.029 | 0.003 | 0.004 E | - | - | - |
| 22 | - | - | - | - | - | - | 0.077 | 0.004 | 0.003 E | - | - | - |
| 23 | - | - | - | - | - | - | 0.070 | 0.004 | 0.002 E | - | - | - |
| 24 | - | - | - | - | - | - | 0.047 | 0.002 | 0.002 E | - | - | - |
| 25 | - | - | - | - | - | - | 0.091 | 0.001 | - | - | - | - |
| 26 | - | - | - | - | - | 0.206 P | 0.282 | 0.001 | - | - | - | - |
| 27 | - | - | - | - | - | 0.169 | 0.269 | 0.003 | - | - | - | - |
| 28 | - | - | - | - | - | 0.135 | 0.213 | 0.004 | - | - | - | - |
| 29 | - | - | - | - | - | 0.143 | 0.189 | 0.012 | - | - | - | - |
| 30 | - | - | - | - | - | 0.140 | 0.237 | 0.040 | - | - | - | - |
| 31 | - | - | - | - | - | - | 0.183 | 0.089 | - | - | - | - |
| MIN | - | - | - | - | - | 0.135 | 0.016 | 0.001 | 0.002 | - | - | - |
| MEAN | - | - | - | - | - | 0.159 | 0.079 | 0.039 | 0.099 | - | - | - |
| MAX | - | - | - | - | - | 0.206 | 0.282 | 0.201 | 0.364 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 98.839 | 98.841 | 98.867 | - | - | - |
| 2 | - | - | - | - | - | - | 98.821 | 98.827 | 98.915 | - | - | - |
| 3 | - | - | - | - | - | - | 98.804 | 98.803 | 98.922 | - | - | - |
| 4 | - | - | - | - | - | - | 98.789 | 98.800 | 98.909 | - | - | - |
| 5 | - | - | - | - | | | 98.774 | 98.790 | 98.891 | - | - | - |
| 6 | - | - | - | - | - | - | 98.764 | 98.791 | 98.868 | - | - | - |
| 7 | - | - | - | - | - | - | 98.757 | 98.766 | 98.847 | - | - | - |
| 8 | - | - | - | - | - | - | 98.746 | 98.751 | 98.834 | - | - | - |
| 9 | - | - | - | - | - | - | 98.745 | 98.744 | 98.825 | - | - | - |
| 10 | - | - | - | - | | | 98.747 | 98.739 | 98.816 | - | - | - |
| 11 | - | - | - | - | - | - | 98.746 | 98.761 | 98.802 P | - | - | - |
| 12 | - | - | - | - | - | - | 98.729 | 98.792 | - | - | - | - |
| 13 | - | - | - | - | - | - | 98.747 | 98.783 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.761 | 98.777 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.752 | 98.791 | - | - | - | - |
| 16 | - | - | - | - | - | - | 98.744 | 98.788 | - | - | - | - |
| 17 | - | - | - | - | - | - | 98.743 | 98.776 | - | - | - | - |
| 18 | - | - | - | - | - | - | 98.733 | 98.736 | - | - | - | - |
| 19 | - | - | - | - | - | - | 98.754 | 98.726 | - | - | - | - |
| 20 | - | - | - | - | - | - | 98.762 | 98.695 | - | - | - | - |
| 21 | - | - | - | - | - | - | 98.755 | 98.670 | - | - | - | - |
| 22 | - | - | - | - | - | - | 98.801 | 98.675 | - | - | - | - |
| 23 | - | - | - | - | - | - | 98.801 | 98.672 | - | - | - | - |
| 24 | - | - | - | - | - | - | 98.780 | 98.662 | - | - | - | - |
| 25 | - | - | - | - | - | - | 98.805 | 98.642 | - | - | - | - |
| 26 | - | - | - | - | - | 98.876 P | 98.900 | 98.628 | - | - | - | - |
| 27 | - | - | - | - | - | 98.861 | 98.897 | 98.666 | - | - | - | - |
| 28 | - | - | - | - | - | 98.846 | 98.878 | 98.674 | - | - | - | - |
| 29 | - | - | - | - | - | 98.850 | 98.870 | 98.716 | - | - | - | - |
| 30 | - | - | - | - | - | 98.849 | 98.878 | 98.771 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.861 | 98.818 | - | - | - | - |
| MIN | - | - | - | - | - | 98.846 | 98.729 | 98.628 | 98.802 | - | - | - |
| MEAN | - | - | - | - | - | 98.856 | 98.790 | 98.744 | 98.863 | - | - | - |
| MAX | - | - | - | - | - | 98.876 | 98.900 | 98.841 | 98.922 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Stickleback Outflow

LOCATION: Outlet of Stickleback Lake

COORDINATES: 442009 m E, 7504121 m N (NAD83)

MEASUREMENT DATE: 26 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:00 h

MEASUREMENT END TIME:11:35 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.00 | 0.01 | | | 0.00 | 0.000 |
| 2 | 0.25 | 0.04 | | | 0.00 | 0.000 |
| 3 | 0.50 | 0.06 | | | 0.00 | 0.000 |
| 4 | 0.75 | 0.08 | | | 0.00 | 0.000 |
| 5 | 1.00 | 0.06 | | | 0.00 | 0.000 |
| 6 | 1.25 | 0.07 | | | 0.00 | 0.000 |
| 7 | 1.50 | 0.10 | | | 0.17 | 0.004 |
| 8 | 1.75 | 0.06 | | | 0.04 | 0.001 |
| 9 | 2.00 | 0.06 | | | 0.01 | 0.000 |
| 10 | 2.25 | 0.08 | | | 0.05 | 0.001 |
| 11 | 2.50 | 0.12 | | | 0.13 | 0.004 |
| 12 | 2.75 | 0.16 | | | 0.13 | 0.005 |
| 13 | 3.00 | 0.11 | | | 0.04 | 0.001 |
| 14 | 3.05 | 0.48 | | | 0.17 | 0.004 |
| 15 | 3.10 | 0.48 | | | 0.35 | 0.013 |
| 16 | 3.20 | 0.33 | | | 0.39 | 0.010 |
| 17 | 3.25 | 0.26 | | | 0.45 | 0.006 |
| 18 | 3.30 | 0.20 | | | 0.36 | 0.011 |
| 19 | 3.55 | 0.21 | | | 0.26 | 0.014 |
| 20 | 3.80 | 0.22 | | | 0.32 | 0.018 |
| 21 | 4.05 | 0.10 | | | 0.07 | 0.002 |
| 22 | 4.30 | 0.05 | | | 0.13 | 0.002 |
| 23 | 4.55 | 0.01 | | | 0.00 | 0.000 |
| Left Bank | 4.80 | 0.01 | | | 0.00 | 0.000 |
| | | | | | | **0.093** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Stickleback Outflow

LOCATION: Outlet of Stickleback Lake

COORDINATES: 442009 m E, 7504121 m N (NAD83)

MEASUREMENT DATE: 5 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:00 h

MEASUREMENT END TIME:11:09 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 2.5 | 0.05 | | | 0.00 | 0.000 |
| 2 | 3.0 | 0.14 | | | 0.04 | 0.002 |
| 3 | 3.2 | 0.15 | | | 0.10 | 0.003 |
| 4 | 3.4 | 0.16 | | | 0.35 | 0.011 |
| 5 | 3.6 | 0.23 | | | 0.29 | 0.013 |
| 6 | 3.8 | 0.19 | | | 0.14 | 0.005 |
| 7 | 4.0 | 0.16 | | | 0.24 | 0.008 |
| 8 | 4.2 | 0.16 | | | 0.20 | 0.006 |
| 9 | 4.4 | 0.12 | | | 0.20 | 0.005 |
| Right Bank | 4.6 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.054** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Stickleback Outflow

LOCATION: Outlet of Stickleback Lake

COORDINATES: 442009 m E, 7504121 m N (NAD83)

MEASUREMENT DATE: 11 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 10:42 h

MEASUREMENT END TIME: 11:09 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|
| | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.00 | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.17 | 0.16 | | | 0.19 | 0.005 |
| 3 | 0.35 | 0.26 | | | 0.67 | 0.030 |
| 4 | 0.52 | 0.22 | | | 0.24 | 0.009 |
| Left Bank | 0.69 | 0.00 | | | 0.00 | 0.000 |
| | | | | | | **0.044** |

PROJECT NAME: Hope Bay Project – Boston Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Stickleback Outflow

LOCATION: Outlet of Stickleback Lake

COORDINATES: 442009 m E, 7504121 m N (NAD83)

MEASUREMENT DATE: 11 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:55 h

MEASUREMENT END TIME:14:20 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | VEGETATION | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.5 | grass | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.7 | grass | 0.10 | | | 0.09 | 0.002 |
| 3 | 0.9 | grass | 0.18 | | | 0.02 | 0.001 |
| 4 | 1.1 | grass | 0.13 | | | 0.04 | 0.001 |
| 5 | 1.3 | grass | 0.14 | | | 0.04 | 0.001 |
| 6 | 1.5 | | 0.16 | | | 0.10 | 0.002 |
| 7 | 1.6 | | 0.24 | | | 0.81 | 0.019 |
| 8 | 1.7 | | 0.40 | | | 1.04 | 0.042 |
| 9 | 1.8 | | 0.40 | | | 0.83 | 0.033 |
| 10 | 1.9 | grass | 0.10 | | | 0.06 | 0.001 |
| Right Bank | 2.0 | grass | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.071** |

## Snow Course Survey Data and Calculations – Open Lake Plots

| **Location** | OL-08-01 | | | **Location** | OL-08-02 | | |
|---|---|---|---|---|---|---|---|
| **Date:** | 21-May-08 | | | **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** | **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] | [cm] | [kg] | [kg] | [g/cm$^3$] |
| 10 | 2.11 | 1.90 | 0.379 | 41 | 3.39 | 2.51 | 0.387 |
| 18 | 2.27 | 1.90 | 0.371 | 10 | 2.75 | 2.51 | 0.433 |
| 14 | 2.20 | 1.90 | 0.387 | 12 | 2.75 | 2.51 | 0.361 |
| **Average:** | | | **0.379** | **Average:** | | | **0.394** |

| **Depth** | **Snow Water Equivalent** | | **Depth** | **Snow Water Equivalent** | |
|---|---|---|---|---|---|
| [cm] | [mm] | | [cm] | [mm] | |
| 24 | 90.9 | | 10 | 39.4 | |
| 10 | 37.9 | | 9 | 35.4 | |
| 10 | 37.9 | | 28 | 110.3 | |
| 7 | 26.5 | | 24 | 94.5 | |
| 5 | 18.9 | | 26 | 102.4 | |
| 11 | 41.7 | | 20 | 78.8 | |
| 9 | 34.1 | | 20 | 78.8 | |
| 10 | 37.9 | | 23 | 90.6 | |
| 19 | 72.0 | | 16 | 63.0 | |
| 18 | 68.2 | | 27 | 106.3 | |
| 2 | 7.6 | | 20 | 78.8 | |
| 9 | 34.1 | | 14 | 55.1 | |
| 18 | 68.2 | | 13 | 51.2 | |
| 29 | 109.9 | | 19 | 74.8 | |
| 17 | 64.4 | | 15 | 59.1 | |
| 27 | 102.3 | | 40 | 157.5 | |
| 25 | 94.7 | | 50 | 196.9 | |
| 17 | 64.4 | | 46 | 181.1 | |
| 6 | 22.7 | | 50 | 196.9 | |
| 3 | 11.4 | | 35 | 137.8 | |
| 0 | 0.0 | | 62 | 244.1 | |
| 1 | 3.8 | | 50 | 196.9 | |
| 1 | 3.8 | | 34 | 133.9 | |
| 4 | 15.2 | | 34 | 133.9 | |
| 1 | 3.8 | | 21 | 82.7 | |
| 16 | 60.6 | | 17 | 66.9 | |
| 11 | 41.7 | | 23 | 90.6 | |
| 7 | 26.5 | | 8 | 31.5 | |
| 1 | 3.8 | | 8 | 31.5 | |
| 27 | 102.3 | | 15 | 59.1 | |
| **11.5** | **43.6** | **Average** | **25.9** | **102.0** | **Average** |

## Snow Course Survey Data and Calculations – Exposed Lowland Plots

| **Location** | EL-08-01 | | |
|---|---|---|---|
| **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 32 | 2.53 | 1.88 | 0.367 |
| 44 | 2.67 | 1.88 | 0.324 |
| 18 | 2.34 | 1.88 | 0.461 |
| **Average:** | | | **0.384** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 22 | 84.5 | |
| 27 | 103.6 | |
| 28 | 107.5 | |
| 29 | 111.3 | |
| 41 | 157.4 | |
| 42 | 161.2 | |
| 13 | 49.9 | |
| 25 | 96.0 | |
| 47 | 180.4 | |
| 28 | 107.5 | |
| 26 | 99.8 | |
| 16 | 61.4 | |
| 18 | 69.1 | |
| 33 | 126.7 | |
| 28 | 107.5 | |
| 44 | 168.9 | |
| 43 | 165.1 | |
| 31 | 119.0 | |
| 41 | 157.4 | |
| 16 | 61.4 | |
| 41 | 157.4 | |
| 46 | 176.6 | |
| 35 | 134.4 | |
| 24 | 92.1 | |
| 33 | 126.7 | |
| 34 | 130.5 | |
| 24 | 92.1 | |
| 32 | 122.8 | |
| 26 | 99.8 | |
| 34 | 130.5 | |
| **30.9** | **118.6** | **Average** |

| **Location** | EL-08-02 | | |
|---|---|---|---|
| **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 18 | 2.98 | 2.5 | 0.481 |
| 27 | 2.98 | 2.5 | 0.321 |
| 17 | 2.79 | 2.5 | 0.308 |
| **Average:** | | | **0.370** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 16 | 59.2 | |
| 19 | 70.3 | |
| 25 | 92.5 | |
| 32 | 118.4 | |
| 34 | 125.8 | |
| 18 | 66.6 | |
| 28 | 103.6 | |
| 15 | 55.5 | |
| 19 | 70.3 | |
| 22 | 81.4 | |
| 27 | 99.9 | |
| 20 | 74.0 | |
| 14 | 51.8 | |
| 35 | 129.5 | |
| 31 | 114.7 | |
| 27 | 99.9 | |
| 24 | 88.8 | |
| 29 | 107.3 | |
| 19 | 70.3 | |
| 28 | 103.6 | |
| 22 | 81.4 | |
| 28 | 103.6 | |
| 31 | 114.7 | |
| 22 | 81.4 | |
| 32 | 118.4 | |
| 17 | 62.9 | |
| 15 | 55.5 | |
| 23 | 85.1 | |
| 10 | 37.0 | |
| 18 | 66.6 | |
| **23.3** | **86.3** | **Average** |

## Snow Course Survey Data and Calculations – Sheltered Lowland Plots

| **Location** | SL-08-01 | | |
|---|---|---|---|
| **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 31.0 | 2.45 | 1.87 | 0.338 |
| 23.0 | 2.22 | 1.87 | 0.275 |
| 20.0 | 2.29 | 1.87 | 0.379 |
| **Average:** | | | **0.330** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 24 | 79.3 | |
| 53 | 175.1 | |
| 36 | 118.9 | |
| 37 | 122.2 | |
| 35 | 115.6 | |
| 44 | 145.4 | |
| 69 | 228.0 | |
| 87 | 287.4 | |
| 38 | 125.5 | |
| 29 | 95.8 | |
| 28 | 92.5 | |
| 34 | 112.3 | |
| 44 | 145.4 | |
| 33 | 109.0 | |
| 15 | 49.6 | |
| 30 | 99.1 | |
| 27 | 89.2 | |
| 24 | 79.3 | |
| 19 | 62.8 | |
| 32 | 105.7 | |
| 29 | 95.8 | |
| 38 | 125.5 | |
| 16 | 52.9 | |
| 54 | 178.4 | |
| 42 | 138.8 | |
| 26 | 85.9 | |
| 24 | 79.3 | |
| 17 | 56.2 | |
| 16 | 52.9 | |
| 25 | 82.6 | |
| **34.2** | **112.9** | **Average** |

| **Location** | SL-08-03 | | |
|---|---|---|---|
| **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 17.0 | 2.26 | 1.94 | 0.340 |
| 13.0 | 2.39 | 1.94 | 0.625 |
| 16.0 | 2.30 | 1.94 | 0.406 |
| **Average:** | | | **0.457** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 13 | 59.4 | |
| 21 | 95.9 | |
| 27 | 123.3 | |
| 14 | 63.9 | |
| 29 | 132.5 | |
| 40 | 182.7 | |
| 26 | 118.8 | |
| 24 | 109.6 | |
| 25 | 114.2 | |
| 21 | 95.9 | |
| 28 | 127.9 | |
| 25 | 114.2 | |
| 33 | 150.7 | |
| 29 | 132.5 | |
| 29 | 132.5 | |
| 31 | 141.6 | |
| 32 | 146.2 | |
| 24 | 109.6 | |
| 23 | 105.1 | |
| 16 | 73.1 | |
| 25 | 114.2 | |
| 23 | 105.1 | |
| 30 | 137.0 | |
| 19 | 86.8 | |
| 18 | 82.2 | |
| 20 | 91.4 | |
| 15 | 68.5 | |
| 23 | 105.1 | |
| 16 | 73.1 | |
| 12 | 54.8 | |
| **23.7** | **108.3** | **Average** |

## Snow Course Survey Data and Calculations – North Aspect Plots

| **Location** | NA-08-01 | | |
|---|---|---|---|
| **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 23 | 2.00 | 1.73 | 0.212 |
| 19 | 1.96 | 1.73 | 0.218 |
| 19 | 2.00 | 1.73 | 0.256 |
| **Average:** | | | **0.229** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 11 | 25.2 | |
| 15 | 34.3 | |
| 0 | 0.0 | |
| 20 | 45.8 | |
| 38 | 87.0 | |
| 36 | 82.4 | |
| 40 | 91.6 | |
| 22 | 50.4 | |
| 12 | 27.5 | |
| 11 | 25.2 | |
| 35 | 80.1 | |
| 27 | 61.8 | |
| 54 | 123.6 | |
| 57 | 130.5 | |
| 43 | 98.4 | |
| 41 | 93.8 | |
| 48 | 109.9 | |
| 51 | 116.7 | |
| 70 | 160.2 | |
| 89 | 203.7 | |
| 106 | 242.6 | |
| 38 | 87.0 | |
| 14 | 32.0 | |
| 11 | 25.2 | |
| 9 | 20.6 | |
| 13 | 29.8 | |
| 15 | 34.3 | |
| 6 | 13.7 | |
| 0 | 0.0 | |
| 14 | 32.0 | |
| **31.5** | **72.2** | **Average** |

| **Location** | NA-08-02 | | |
|---|---|---|---|
| **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 21 | 2.23 | 1.79 | 0.378 |
| 28 | 2.29 | 1.79 | 0.322 |
| 25 | 2.26 | 1.79 | 0.339 |
| **Average:** | | | **0.347** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 0 | 0.0 | |
| 0 | 0.0 | |
| 0 | 0.0 | |
| 22 | 76.2 | |
| 39 | 135.1 | |
| 11 | 38.1 | |
| 21 | 72.8 | |
| 16 | 55.4 | |
| 8 | 27.7 | |
| 11 | 38.1 | |
| 0 | 0.0 | |
| 0 | 0.0 | |
| 0 | 0.0 | |
| 22 | 76.2 | |
| 6 | 20.8 | |
| 8 | 27.7 | |
| 0 | 0.0 | |
| 22 | 76.2 | |
| 34 | 117.8 | |
| 33 | 114.4 | |
| 0 | 0.0 | |
| 12 | 41.6 | |
| 0 | 0.0 | |
| 85 | 294.5 | |
| 0 | 0.0 | |
| 3 | 10.4 | |
| 11 | 38.1 | |
| 30 | 104.0 | |
| 38 | 131.7 | |
| 3 | 10.4 | |
| **14.5** | **50.2** | **Average** |

## Snow Course Survey Data and Calculations – East Aspect Plots

| **Location** | EA-08-02 | | |
|---|---|---|---|
| **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 77 | 3.83 | 2.56 | 0.298 |
| 80 | 3.76 | 2.56 | 0.271 |
| 27 | 2.96 | 2.56 | 0.267 |
| **Average:** | | | **0.279** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 130 | 362.1 | |
| 99 | 275.8 | |
| 57 | 158.8 | |
| 30 | 83.6 | |
| 33 | 91.9 | |
| 35 | 97.5 | |
| 29 | 80.8 | |
| 34 | 94.7 | |
| 64 | 178.3 | |
| 47 | 130.9 | |
| 12 | 33.4 | |
| 40 | 111.4 | |
| 53 | 147.6 | |
| 30 | 83.6 | |
| 35 | 97.5 | |
| 35 | 97.5 | |
| 27 | 75.2 | |
| 33 | 91.9 | |
| 34 | 94.7 | |
| 29 | 80.8 | |
| 38 | 105.8 | |
| 78 | 217.3 | |
| 47 | 130.9 | |
| 60 | 167.1 | |
| 95 | 264.6 | |
| 64 | 178.3 | |
| 72 | 200.5 | |
| 65 | 181.1 | |
| 56 | 156.0 | |
| 53 | 147.6 | |
| **50.5** | **140.6** | **Average** |

| **Location** | EA-08-3 | | |
|---|---|---|---|
| **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 26 | 2.46 | 1.87 | 0.409 |
| 18 | 2.34 | 1.87 | 0.471 |
| 41 | 2.69 | 1.87 | 0.361 |
| **Average:** | | | **0.414** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 21 | 86.9 | |
| 23 | 95.2 | |
| 31 | 128.3 | |
| 32 | 132.4 | |
| 27 | 111.7 | |
| 38 | 157.3 | |
| 25 | 103.5 | |
| 32 | 132.4 | |
| 30 | 124.2 | |
| 9 | 37.2 | |
| 34 | 140.7 | |
| 39 | 161.4 | |
| 38 | 157.3 | |
| 37 | 153.1 | |
| 29 | 120.0 | |
| 26 | 107.6 | |
| 25 | 103.5 | |
| 23 | 95.2 | |
| 36 | 149.0 | |
| 16 | 66.2 | |
| 24 | 99.3 | |
| 33 | 136.6 | |
| 88 | 364.2 | |
| 83 | 343.5 | |
| 83 | 343.5 | |
| 72 | 298.0 | |
| 0 | 0.0 | |
| 24 | 99.3 | |
| 47 | 194.5 | |
| 16 | 66.2 | |
| **34.7** | **143.6** | **Average** |

## Snow Course Survey Data and Calculations – South Aspect Plots

| **Location** | SA-08-02 | | | **Location** | SA-08-03 | | |
|---|---|---|---|---|---|---|---|
| **Date:** | 20-May-08 | | | **Date:** | 21-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** | **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] | [cm] | [kg] | [kg] | [g/cm$^3$] |
| 34 | 2.96 | 2.48 | 0.255 | 112 | 4.08 | 1.82 | 0.364 |
| 70 | 3.66 | 2.48 | 0.304 | 65 | 3.26 | 1.82 | 0.400 |
| 25 | 3.02 | 2.48 | 0.390 | 56 | 3.00 | 1.82 | 0.380 |
| **Average:** | | | **0.316** | **Average:** | | | **0.381** |

| **Depth** | **Snow Water Equivalent** | | **Depth** | **Snow Water Equivalent** | |
|---|---|---|---|---|---|
| [cm] | [mm] | | [cm] | [mm] | |
| 36 | 113.8 | | 221 | 842.8 | |
| 36 | 113.8 | | 223 | 850.5 | |
| 42 | 132.8 | | 182 | 694.1 | |
| 46 | 145.5 | | 147 | 560.6 | |
| 58 | 183.4 | | 114 | 434.8 | |
| 57 | 180.3 | | 74 | 282.2 | |
| 8 | 25.3 | | 73 | 278.4 | |
| 5 | 15.8 | | 50 | 190.7 | |
| 19 | 60.1 | | 58 | 221.2 | |
| 17 | 53.8 | | 40 | 152.5 | |
| 11 | 34.8 | | 35 | 133.5 | |
| 24 | 75.9 | | 18 | 68.6 | |
| 23 | 72.7 | | 8 | 30.5 | |
| 26 | 82.2 | | 0 | 0.0 | |
| 19 | 60.1 | | 66 | 251.7 | |
| 17 | 53.8 | | 7 | 26.7 | |
| 0 | 0.0 | | 34 | 129.7 | |
| 2 | 6.3 | | 19 | 72.5 | |
| 3 | 9.5 | | 18 | 68.6 | |
| 3 | 9.5 | | 22 | 83.9 | |
| 27 | 85.4 | | 4 | 15.3 | |
| 38 | 120.2 | | 0 | 0.0 | |
| 36 | 113.8 | | 46 | 175.4 | |
| 41 | 129.7 | | 36 | 137.3 | |
| 27 | 85.4 | | 0 | 0.0 | |
| 31 | 98.0 | | 3 | 11.4 | |
| 56 | 177.1 | | 22 | 83.9 | |
| 33 | 104.4 | | 59 | 225.0 | |
| 52 | 164.4 | | 84 | 320.4 | |
| 47 | 148.6 | | 57 | 217.4 | |
| **28.0** | **88.5** | **Average** | **57.3** | **218.7** | **Average** |

## Snow Course Survey Data and Calculations – West Aspect Plots

| **Location** | WA-08-02 | | |
|---|---|---|---|
| **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 20 | 2.87 | 2.47 | 0.361 |
| 30 | 2.98 | 2.47 | 0.307 |
| 15 | 2.7 | 2.47 | 0.277 |
| **Average:** | | | **0.315** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 9 | 28.3 | |
| 17 | 53.5 | |
| 4 | 12.6 | |
| 21 | 66.1 | |
| 8 | 25.2 | |
| 32 | 100.7 | |
| 16 | 50.4 | |
| 17 | 53.5 | |
| 44 | 138.5 | |
| 45 | 141.7 | |
| 36 | 113.3 | |
| 27 | 85.0 | |
| 28 | 88.1 | |
| 20 | 63.0 | |
| 14 | 44.1 | |
| 24 | 75.5 | |
| 19 | 59.8 | |
| 23 | 72.4 | |
| 16 | 50.4 | |
| 19 | 59.8 | |
| 13 | 40.9 | |
| 14 | 44.1 | |
| 5 | 15.7 | |
| 8 | 25.2 | |
| 27 | 85.0 | |
| 30 | 94.4 | |
| 2 | 6.3 | |
| 14 | 44.1 | |
| 0 | 0.0 | |
| 6 | 18.9 | |
| **18.6** | **58.5** | **Average** |

| **Location** | WA-08-03 | | |
|---|---|---|---|
| **Date:** | 20-May-08 | | |
| **Depth** | **Weight** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 120 | 4.99 | 2.49 | 0.376 |
| 57 | 3.5 | 2.49 | 0.320 |
| 65 | 3.71 | 2.49 | 0.339 |
| **Average:** | | | **0.345** |

| **Depth** | **Snow Water Equivalent** | |
|---|---|---|
| [cm] | [mm] | |
| 68 | 234.5 | |
| 73 | 251.7 | |
| 68 | 234.5 | |
| 75 | 258.6 | |
| 95 | 327.5 | |
| 94 | 324.1 | |
| 88 | 303.4 | |
| 95 | 327.5 | |
| 55 | 189.6 | |
| 54 | 186.2 | |
| 85 | 293.1 | |
| 68 | 234.5 | |
| 48 | 165.5 | |
| 43 | 148.3 | |
| 39 | 134.5 | |
| 50 | 172.4 | |
| 45 | 155.2 | |
| 68 | 234.5 | |
| 71 | 244.8 | |
| 54 | 186.2 | |
| 117 | 403.4 | |
| 118 | 406.8 | |
| 127 | 437.9 | |
| 102 | 351.7 | |
| 45 | 155.2 | |
| 56 | 193.1 | |
| 48 | 165.5 | |
| 81 | 279.3 | |
| 81 | 279.3 | |
| 69 | 237.9 | |
| **72.7** | **250.5** | **Average** |

# APPENDIX A2

# HYDROLOGY DATA FOR DORIS PROJECT AREA

# A1 HYDROLOGY DATA FOR DORIS PROJECT AREA

This appendix contains hydrology data referenced in the body of the report. A table of contents for the appendix follows:


| Station | Description | Page |
|---|---|---|
| **HYDROMETRY** | | |
| H71 – Doris Outflow | Factsheet | A2-3 |
| | Stage-Discharge Rating Curve (2008) | A2-4 |
| | Stage-Discharge Data (2008) | A2-4 |
| | Mean Daily Discharge and Water Level Data (2008) | A2-5 |
| | Discharge Data Sheets (2008) | A2-6 |
| H72 – Roberts Lake and Outflow | Factsheet | A2-10 |
| | Stage-Discharge Rating Curve (2008) | A2-11 |
| | Stage-Discharge Data (2008) | A2-11 |
| | Mean Daily Discharge and Water Level Data (2008) | A2-12 |
| | Discharge Data Sheets (2008) | A2-13 |
| H73 – Little Roberts Outflow | Factsheet | A2-17 |
| | Stage-Discharge Rating Curve (2008) | A2-18 |
| | Stage-Discharge Data (2008) | A2-18 |
| | Mean Daily Discharge and Water Level Data (2008) | A2-19 |
| | Discharge Data Sheets (2008) | A2-20 |
| H74 – Doris Lake | Factsheet | A2-23 |
| | Stage Data (2008) | A2-24 |
| | Mean Daily Water Level and Water Temperature Data (2007) | A2-25 |
| | Mean Daily Water Level and Water Temperature Data (2008) | A2-26 |
| H75 – Tail Lake | Factsheet | A2-27 |
| | Stage Data (2008) | A2-28 |
| | Mean Daily Water Level and Water Temperature Data (2007) | A2-29 |
| | Mean Daily Water Level and Water Temperature Data (2008) | A2-30 |
| H76 – Tail Lake and Outflow | Factsheet | A2-31 |
| | Stage-Discharge Rating Curve (2008) | A2-32 |
| | Stage-Discharge Data (2008) | A2-32 |
| | Mean Daily Discharge and Water Level Data (2008) | A2-33 |
| | Discharge Data Sheets (2008) | A2-34 |
| **SNOW COURSE SURVEY** | | |
| Open Lake Plots | Snow Course Survey Data and Calculations | A2-38 |
| Exposed Lowland Plots | Snow Course Survey Data and Calculations | A2-39 |
| Sheltered Lowland Plots | Snow Course Survey Data and Calculations | A2-40 |
| North Aspect Plots | Snow Course Survey Data and Calculations | A2-41 |
| East Aspect Plots | Snow Course Survey Data and Calculations | A2-42 |
| South Aspect Plots | Snow Course Survey Data and Calculations | A2-43 |
| West Aspect Plots | Snow Course Survey Data and Calculations | A2-44 |

# DORIS OUTFLOW HYDROMETRIC STATION

# H71

FACTSHEET

## *LOCATION AND DETAILS*

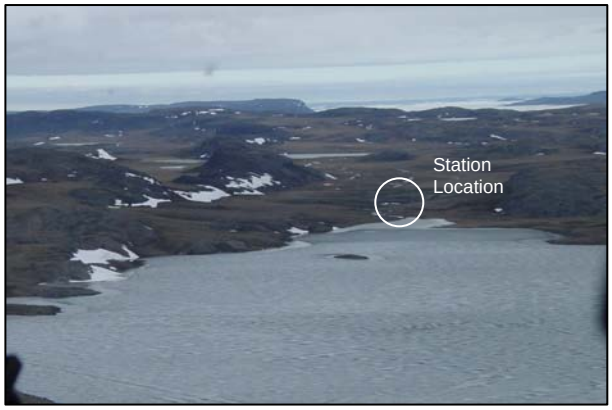
Located on the right downstream bank of Doris Outflow, approximately 50 m downstream of the lake.

| Operational: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| | 30/6-9/9 | 8/6-11/9 | 27/6-17/9 | 26/6-8/9 | 23/6-14/9 | 22/6-12/9 | |

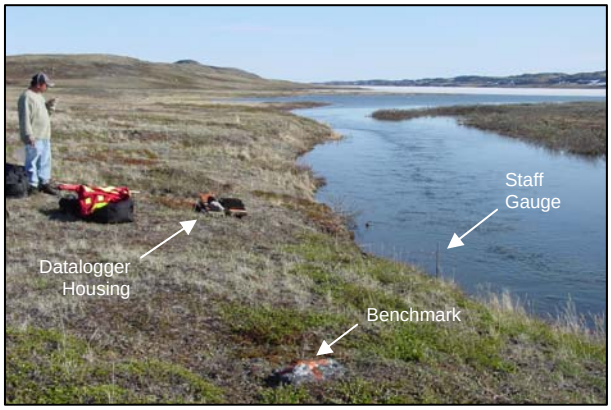
Benchmark: Top of embedded boulder; 22.593 m (geodetic) Drainage Area: 93.1 km$^2$

Coordinates: UTM: 434063 m E, 7559507 m N (Zone 13W NAD83) Lat/Long: 68°08'30" N, 106°35'16" W

Equipment: Optimum Instruments Datalogger, Transducer



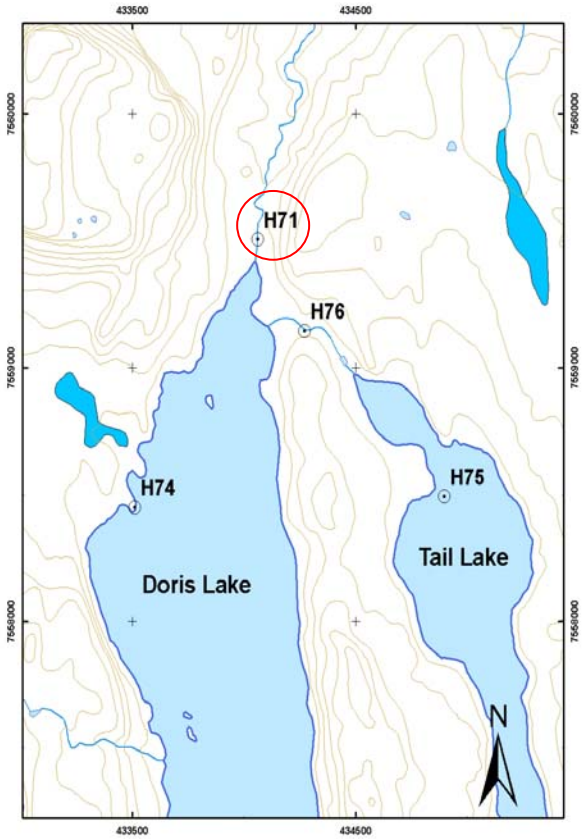

Aerial view of Doris Lake looking north along outlet channel.




Doris Creek looking south from Station H71 to lake outlet.

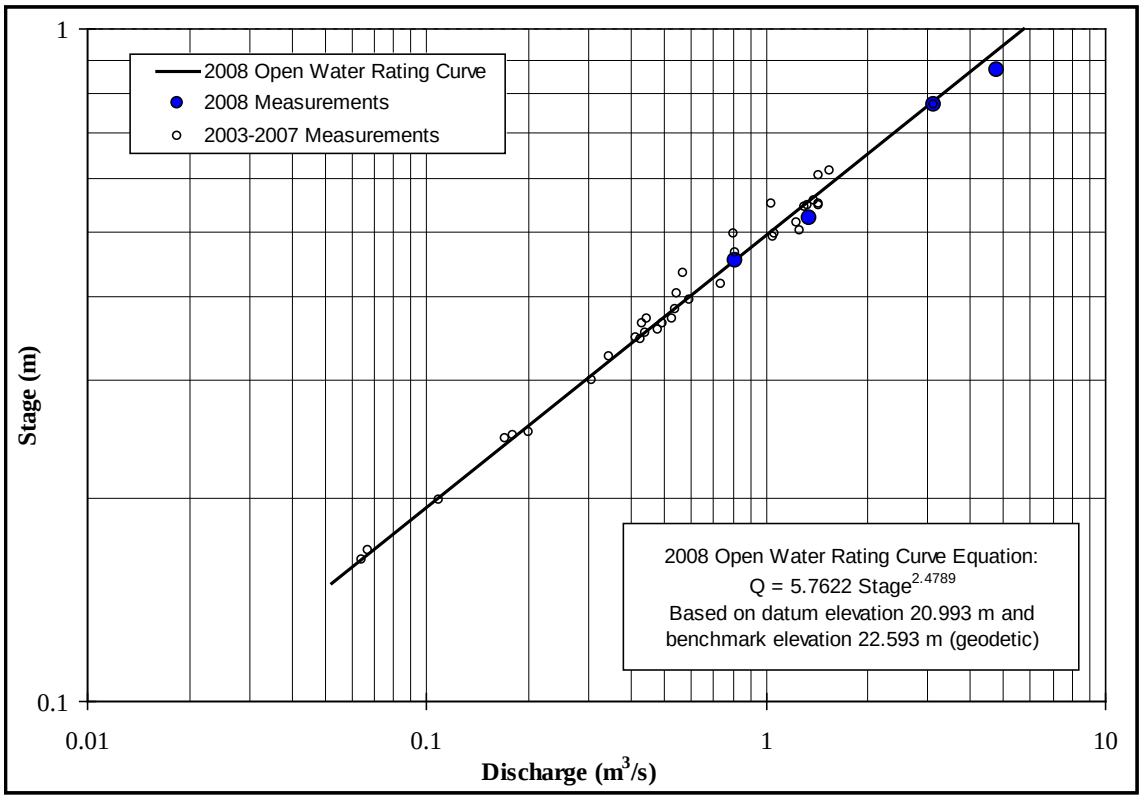
Station H71 from RDB looking northwest.

Station H71 from RDB looking southeast.




NTS Mapping of Area.

FACT-H71-2008.DOC




**Doris Outflow Station H71 – Stage-Discharge Rating Curve (2008)**

**Doris Outflow Station H71 – Stage-Discharge Data (2008)**

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 22-Jun-2008 14:05 | 21.860 | 1.030 | 20.830 | 20.846 | 0.867 | 4.783 |
| 01-Jul-2008 11:05 | 21.765 | 0.926 | 20.839 | | 0.772 | 3.123 |
| 09-Aug-2008 14:44 | 21.445 | 0.593 | 20.852 | | 0.452 | 0.808 |
| 12-Sep-2008 10:59 | 21.517 | 0.653 | 20.864 | | 0.524 | 1.344 |

## H71 – DORIS OUTFLOW – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 3.086 | 1.114 | 0.720 | 0.347 E | - | - |
| 2 | - | - | - | - | - | - | 2.946 | 1.052 | 0.801 | 0.300 E | - | - |
| 3 | - | - | - | - | - | 0.011 E | 2.801 | 0.979 | 0.854 | 0.253 E | - | - |
| 4 | - | - | - | - | - | 0.018 E | 2.654 | 0.942 | 0.889 | 0.206 E | - | - |
| 5 | - | - | - | - | - | 0.026 E | 2.513 | 0.917 | 0.913 | 0.159 E | - | - |
| 6 | - | - | - | - | - | 0.039 E | 2.391 | 0.884 | 0.939 | 0.112 E | - | - |
| 7 | - | - | - | - | - | 0.057 E | 2.273 | 0.846 | 0.958 | 0.086 E | - | - |
| 8 | - | - | - | - | - | 0.075 E | 2.153 | 0.809 | 0.971 | 0.058 E | - | - |
| 9 | - | - | - | - | - | 0.125 E | 2.051 | 0.773 | 0.998 | 0.038 E | - | - |
| 10 | - | - | - | - | - | 0.239 E | 1.956 | 0.755 | 1.045 | 0.017 E | - | - |
| 11 | - | - | - | - | - | 0.433 E | 1.891 | 0.736 | 1.073 | 0.000 E | - | - |
| 12 | - | - | - | - | - | 0.638 E | 1.843 | 0.753 | 1.074 | 0.000 E | - | - |
| 13 | - | - | - | - | - | 1.019 E | 1.795 | 0.744 | 1.060 E | 0.000 E | - | - |
| 14 | - | - | - | - | - | 1.484 E | 1.722 | 0.730 | 1.045 E | 0.000 E | - | - |
| 15 | - | - | - | - | - | 1.928 E | 1.651 | 0.703 | 1.020 E | 0.000 E | - | - |
| 16 | - | - | - | - | - | 2.580 E | 1.589 | 0.678 | 0.988 E | 0.000 E | - | - |
| 17 | - | - | - | - | - | 3.130 E | 1.536 | 0.647 | 0.958 E | 0.000 E | - | - |
| 18 | - | - | - | - | - | 3.600 E | 1.484 | 0.628 | 0.928 E | 0.000 E | - | - |
| 19 | - | - | - | - | - | 3.934 E | 1.472 | 0.591 | 0.891 E | 0.000 E | - | - |
| 20 | - | - | - | - | - | 4.121 E | 1.459 | 0.575 | 0.854 E | 0.000 E | - | - |
| 21 | - | - | - | - | - | 4.203 E | 1.402 | 0.548 | 0.817 E | 0.000 E | - | - |
| 22 | - | - | - | - | - | 4.293 P | 1.335 | 0.536 | 0.770 E | 0.000 E | - | - |
| 23 | - | - | - | - | - | 4.231 | 1.293 | 0.536 | 0.723 E | 0.000 E | - | - |
| 24 | - | - | - | - | - | 4.130 | 1.242 | 0.525 | 0.676 E | - | - | - |
| 25 | - | - | - | - | - | 3.996 | 1.191 | 0.507 | 0.629 E | - | - | - |
| 26 | - | - | - | - | - | 3.852 | 1.273 | 0.485 | 0.582 E | - | - | - |
| 27 | - | - | - | - | - | 3.670 | 1.245 | 0.504 | 0.535 E | - | - | - |
| 28 | - | - | - | - | - | 3.500 | 1.209 | 0.494 | 0.488 E | - | - | - |
| 29 | - | - | - | - | - | 3.355 | 1.175 | 0.515 | 0.441 E | - | - | - |
| 30 | - | - | - | - | - | 3.215 | 1.156 | 0.573 | 0.394 E | - | - | - |
| 31 | - | - | - | - | - | - | 1.114 | 0.640 | - | - | - | - |
| MIN | - | - | - | - | - | 0.011 | 1.114 | 0.485 | 0.394 | - | - | - |
| MEAN | - | - | - | - | - | 2.211 | 1.771 | 0.701 | 0.834 | - | - | - |
| MAX | - | - | - | - | - | 4.293 | 3.086 | 1.114 | 1.074 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 22.593 m**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 21.770 | 21.508 | 21.425 | - | - | - |
| 2 | - | - | - | - | - | - | 21.756 | 21.496 | 21.444 | - | - | - |
| 3 | - | - | - | - | - | - | 21.741 | 21.482 | 21.456 | - | - | - |
| 4 | - | - | - | - | - | - | 21.724 | 21.475 | 21.464 | - | - | - |
| 5 | - | - | - | - | - | - | 21.709 | 21.470 | 21.468 | - | - | - |
| 6 | - | - | - | - | - | - | 21.694 | 21.462 | 21.474 | - | - | - |
| 7 | - | - | - | - | - | - | 21.680 | 21.454 | 21.478 | - | - | - |
| 8 | - | - | - | - | - | - | 21.665 | 21.446 | 21.480 | - | - | - |
| 9 | - | - | - | - | - | - | 21.652 | 21.438 | 21.486 | - | - | - |
| 10 | - | - | - | - | - | - | 21.640 | 21.433 | 21.495 | - | - | - |
| 11 | - | - | - | - | - | - | 21.631 | 21.429 | 21.500 | - | - | - |
| 12 | - | - | - | - | - | - | 21.624 | 21.433 | 21.501 P | - | - | - |
| 13 | - | - | - | - | - | - | 21.618 | 21.431 | - | - | - | - |
| 14 | - | - | - | - | - | - | 21.607 | 21.428 | - | - | - | - |
| 15 | - | - | - | - | - | - | 21.597 | 21.421 | - | - | - | - |
| 16 | - | - | - | - | - | - | 21.588 | 21.415 | - | - | - | - |
| 17 | - | - | - | - | - | - | 21.580 | 21.407 | - | - | - | - |
| 18 | - | - | - | - | - | - | 21.572 | 21.402 | - | - | - | - |
| 19 | - | - | - | - | - | - | 21.570 | 21.392 | - | - | - | - |
| 20 | - | - | - | - | - | - | 21.567 | 21.388 | - | - | - | - |
| 21 | - | - | - | - | - | - | 21.558 | 21.380 | - | - | - | - |
| 22 | - | - | - | - | - | 21.881 P | 21.547 | 21.377 | - | - | - | - |
| 23 | - | - | - | - | - | 21.876 | 21.540 | 21.377 | - | - | - | - |
| 24 | - | - | - | - | - | 21.867 | 21.531 | 21.373 | - | - | - | - |
| 25 | - | - | - | - | - | 21.856 | 21.522 | 21.368 | - | - | - | - |
| 26 | - | - | - | - | - | 21.843 | 21.537 | 21.361 | - | - | - | - |
| 27 | - | - | - | - | - | 21.827 | 21.532 | 21.367 | - | - | - | - |
| 28 | - | - | - | - | - | 21.811 | 21.526 | 21.364 | - | - | - | - |
| 29 | - | - | - | - | - | 21.797 | 21.519 | 21.370 | - | - | - | - |
| 30 | - | - | - | - | - | 21.783 | 21.516 | 21.387 | - | - | - | - |
| 31 | - | - | - | - | - | - | 21.508 | 21.405 | - | - | - | - |
| MIN | - | - | - | - | - | 21.783 | 21.508 | 21.361 | 21.425 | - | - | - |
| MEAN | - | - | - | - | - | 21.838 | 21.607 | 21.417 | 21.473 | - | - | - |
| MAX | - | - | - | - | - | 21.881 | 21.770 | 21.508 | 21.501 | - | - | - |

E- ESTIMATED P – PARTIAL DAILY

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Doris Outflow

LOCATION: Outlet of Doris Lake

COORDINATES: 434063 m E, 7559507 m N (NAD83)

MEASUREMENT DATE: 22 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME:1300 h

MEASUREMENT END TIME:1330 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Left Bank | 0.0 | | 0.06 | | | 0.00 | 0.000 |
| 1 | 1.0 | | 0.06 | | | 0.00 | 0.000 |
| 2 | 2.0 | | 0.00 | | | 0.00 | 0.000 |
| 3 | 3.0 | | 0.06 | | | 0.00 | 0.000 |
| 4 | 4.0 | | 0.00 | | | 0.00 | 0.000 |
| 5 | 5.0 | | 0.00 | | | 0.00 | 0.000 |
| 6 | 6.0 | | 0.04 | | | 0.00 | 0.000 |
| 7 | 7.0 | | 0.00 | | | 0.00 | 0.000 |
| 8 | 8.0 | | 0.12 | | | 0.12 | 0.014 |
| 9 | 9.0 | | 0.50 | | | 0.24 | 0.120 |
| 10 | 10.0 | | 0.60 | | | 0.39 | 0.234 |
| 11 | 11.0 | | 0.60 | | | 0.41 | 0.246 |
| 12 | 12.0 | | 0.58 | | | 0.51 | 0.296 |
| 13 | 13.0 | | 0.60 | | | 0.58 | 0.348 |
| 14 | 14.0 | | 0.70 | | | 0.57 | 0.399 |
| 15 | 15.0 | | 0.72 | | | 0.50 | 0.360 |
| 16 | 16.0 | | 0.89 | 0.71 | 0.66 | | 0.610 |
| 17 | 17.0 | | 1.06 | 0.91 | 0.67 | | 0.837 |
| 18 | 18.0 | | 0.98 | 0.86 | 0.84 | | 0.833 |
| 19 | 19.0 | | 0.84 | 0.61 | 0.52 | | 0.475 |
| 20 | 20.0 | | 0.12 | | | 0.16 | 0.012 |
| Right Bank | 20.2 | | 0.02 | | | 0.00 | 0.000 |
| | | | | | | | **4.783** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Doris Outflow

LOCATION: Outlet of Doris Lake

COORDINATES: 434063 m E, 7559507 m N (NAD83)

MEASUREMENT DATE: 1 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:15 h

MEASUREMENT END TIME:11:50 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 13.0 | | 0.00 | | | | 0.000 |
| 2 | 12.5 | | 0.34 | | | 0.05 | 0.006 |
| 3 | 12.3 | | 0.54 | | | 0.18 | 0.024 |
| 4 | 12.0 | | 0.56 | | | 0.32 | 0.072 |
| 5 | 11.5 | | 0.65 | | | 0.37 | 0.120 |
| 6 | 11.0 | | 0.96 | 0.54 | 0.36 | | 0.216 |
| 7 | 10.5 | | 1.00 | 0.60 | 0.28 | | 0.220 |
| 8 | 10.0 | | 1.00 | 0.74 | 0.65 | | 0.348 |
| 9 | 9.5 | | 1.00 | 0.76 | 0.64 | | 0.350 |
| 10 | 9.0 | | 0.96 | 0.78 | 0.65 | | 0.343 |
| 11 | 8.5 | | 0.94 | 0.73 | 0.64 | | 0.322 |
| 12 | 8.0 | | 0.76 | 0.53 | 0.30 | | 0.158 |
| 13 | 7.5 | | 0.64 | | | 0.41 | 0.131 |
| 14 | 7.0 | | 0.60 | | | 0.32 | 0.096 |
| 15 | 6.5 | | 0.52 | | | 0.49 | 0.127 |
| 16 | 6.0 | | 0.46 | | | 0.47 | 0.162 |
| 17 | 5.0 | | 0.44 | | | 0.30 | 0.132 |
| 18 | 4.0 | | 0.46 | | | 0.21 | 0.097 |
| 19 | 3.0 | | 0.46 | | | 0.25 | 0.115 |
| 20 | 2.0 | | 0.44 | | | 0.10 | 0.033 |
| 21 | 1.5 | | 0.34 | | | 0.20 | 0.034 |
| 22 | 1.0 | | 0.24 | | | 0.14 | 0.017 |
| Right Bank | 0.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **3.123** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Doris Outflow

LOCATION: Outlet of Doris Lake

COORDINATES: 434063 m E, 7559507 m N (NAD83)

MEASUREMENT DATE: 9 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 15:05 h

MEASUREMENT END TIME: 15:28 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.3 | | 0.26 | | | 0.31 | 0.024 |
| 3 | 0.6 | | 0.28 | | | 0.77 | 0.065 |
| 4 | 0.9 | | 0.32 | | | 0.63 | 0.060 |
| 5 | 1.2 | | 0.24 | | | 0.67 | 0.048 |
| 6 | 1.5 | | 0.28 | | | 0.65 | 0.055 |
| 7 | 1.8 | | 0.25 | | | 0.74 | 0.056 |
| 8 | 2.1 | | 0.25 | | | 0.80 | 0.060 |
| 9 | 2.4 | | 0.29 | | | 0.66 | 0.057 |
| 10 | 2.7 | | 0.28 | | | 0.66 | 0.055 |
| 11 | 3.0 | | 0.36 | | | 0.52 | 0.056 |
| 12 | 3.3 | | 0.40 | | | 0.59 | 0.071 |
| 13 | 3.6 | | 0.42 | | | 0.80 | 0.101 |
| 14 | 3.9 | | 0.44 | | | 0.64 | 0.084 |
| 15 | 4.2 | | 0.48 | | | 0.16 | 0.015 |
| Left Bank | 4.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.808** |

PROJECT NAME: Hope Bay Project – Doris Area
PROJECT NUMBER: 08-1373-0026.2000
DISCHARGE DATA

STREAM NAME: Doris Outflow
LOCATION: Outlet of Doris Lake
COORDINATES: 434063 m E, 7559507 m N (NAD83)

MEASUREMENT DATE: 12 September 2008
METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH
COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 15:05 h
MEASUREMENT END TIME: 15:28 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.10 | | | 0.00 | 0.000 |
| 3 | 1.5 | | 0.10 | | | 0.00 | 0.000 |
| 4 | 2.0 | | 0.36 | | | 0.04 | 0.006 |
| 5 | 2.4 | | 0.34 | | | 0.05 | 0.004 |
| 6 | 2.5 | | 0.34 | | | 0.43 | 0.022 |
| 7 | 2.7 | | 0.42 | | | 0.73 | 0.061 |
| 8 | 2.9 | | 0.46 | | | 1.04 | 0.120 |
| 9 | 3.2 | | 0.38 | | | 0.83 | 0.095 |
| 10 | 3.5 | | 0.40 | | | 0.82 | 0.098 |
| 11 | 3.8 | | 0.38 | | | 0.99 | 0.113 |
| 12 | 4.1 | | 0.40 | | | 0.93 | 0.112 |
| 13 | 4.4 | | 0.46 | | | 0.96 | 0.132 |
| 14 | 4.7 | | 0.46 | | | 0.85 | 0.117 |
| 15 | 5.0 | | 0.48 | | | 0.89 | 0.128 |
| 16 | 5.3 | | 0.48 | | | 1.01 | 0.145 |
| 17 | 5.6 | | 0.50 | | | 0.82 | 0.103 |
| 18 | 5.8 | | 0.50 | | | 0.59 | 0.059 |
| 19 | 6.0 | | 0.42 | | | 0.33 | 0.028 |
| 20 | 6.2 | | 0.18 | | | 0.01 | 0.000 |
| 21 | 6.3 | | 0.18 | | | 0.00 | 0.000 |
| Right Bank | 10.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.344** |

# ROBERTS LAKE AND OUTFLOW HYDROMETRIC STATION

**H72**

**FACTSHEET**

## *LOCATION AND DETAILS*

Located on the right downstream bank of Roberts Lake, approximately 20 m upstream of the lake outlet.

| Operational: | 2003<br>30/6-9/9 | 2004<br>9/5-13/9 | 2005<br>29/6-17/9 | 2006<br>29/6-6/9 | 2007<br>5/6-14/9 | 2008<br>19/6-12/9 | 2009 |
|---|---|---|---|---|---|---|---|

Benchmark: Rock bolt in bedrock; 6.958 m (geodetic) Drainage Area: 97.8 km$^2$

Coordinates: UTM: 435289 m E, 7562800 m N (Zone 13W NAD83) Lat/Long: 68°10'17" N, 106°33'35" W

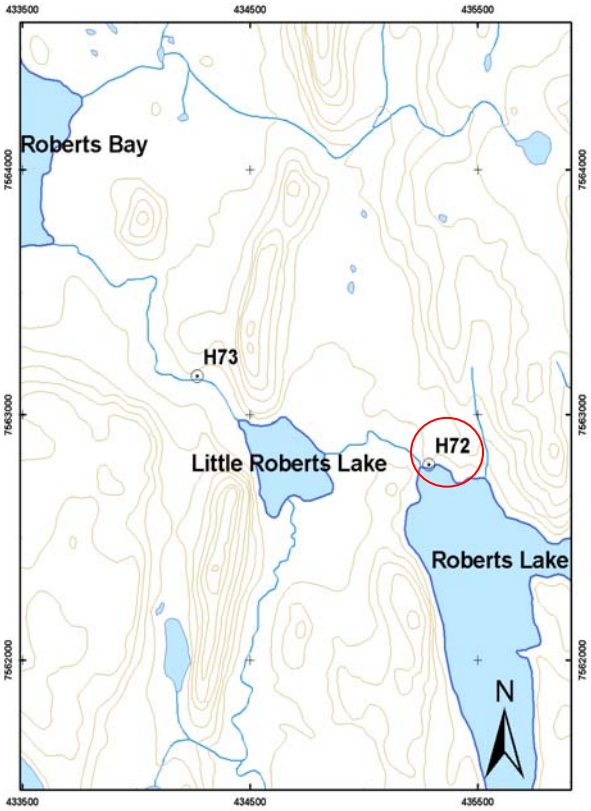
Equipment: Optimum Instruments Datalogger, KPSI Transducer

Aerial view of Roberts Lake Outlet looking northeast.

Station H72 from lake looking northwest.

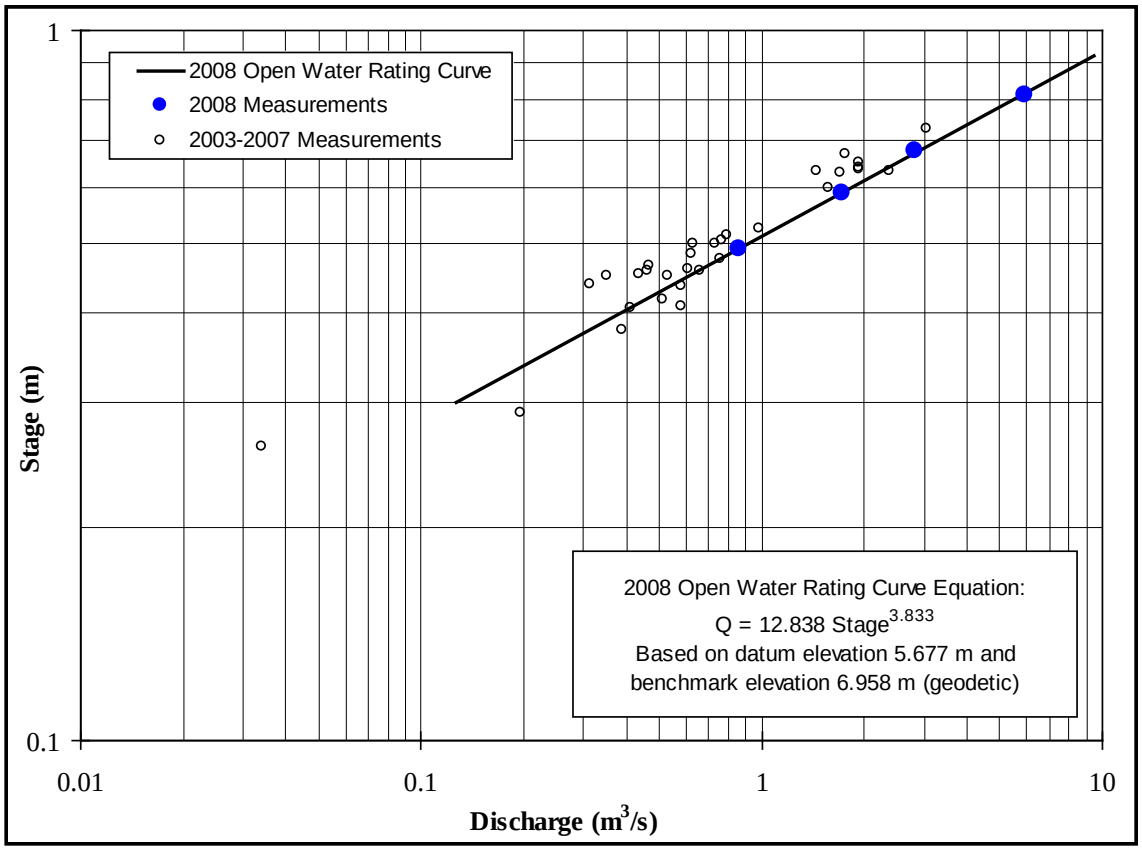
Station H72 from bank looking southeast.

Station H72 from bank looking west at new benchmark.




NTS Mapping of Area.

FACT-H72-2008.DOC




**Roberts Outflow Station H72 – Stage-Discharge Rating Curve (2008)**

**Roberts Outflow Station H72 – Stage-Discharge Data (2008)**

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 19-Jun-2008 13:05 | 6.499 | 0.981 | 5.518 | 5.510 | 0.814 | 5.898 |
| 02-Jul-2008 12:55 | 6.367 | 0.844 | 5.523 | | 0.677 | 2.808 |
| 09-Aug-2008 14:20 | 6.158 | 0.659 | 5.499 | | 0.492 | 0.851 |
| 12-Sep-2008 12:15 | 6.258 | 0.759 | 5.499 | | 0.591 | 1.727 |

## H72 – ROBERTS LAKE AND OUTFLOW – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 3.175 | 1.152 | 1.535 | 0.195 E | - | - |
| 2 | - | - | - | - | - | - | 2.901 | 1.115 | 1.886 | 0.155 E | - | - |
| 3 | - | - | - | - | - | 0.045 E | 2.631 | 1.051 | 2.119 | 0.115 E | - | - |
| 4 | - | - | - | - | - | 0.085 E | 2.405 | 1.024 | 2.218 | 0.077 E | - | - |
| 5 | - | - | - | - | - | 0.132 E | 2.166 | 0.979 | 2.212 | 0.056 E | - | - |
| 6 | - | - | - | - | - | 0.164 E | 1.960 | 0.937 | 2.137 | 0.034 E | - | - |
| 7 | - | - | - | - | - | 0.208 E | 1.791 | 0.908 | 2.031 | 0.024 E | - | - |
| 8 | - | - | - | - | - | 0.271 E | 1.639 | 0.889 | 1.928 | 0.018 E | - | - |
| 9 | - | - | - | - | - | 0.340 E | 1.484 | 0.855 | 1.859 P | - | - | - |
| 10 | - | - | - | - | - | 0.520 E | 1.400 | 0.853 | 1.841 E | - | - | - |
| 11 | - | - | - | - | - | 0.760 E | 1.331 | 0.851 | 1.786 E | - | - | - |
| 12 | - | - | - | - | - | 1.160 E | 1.249 | 0.905 | 1.727 E | - | - | - |
| 13 | - | - | - | - | - | 1.710 E | 1.199 | 0.926 | 1.620 E | - | - | - |
| 14 | - | - | - | - | - | 2.200 E | 1.131 | 0.955 | 1.520 E | - | - | - |
| 15 | - | - | - | - | - | 2.740 E | 1.073 | 0.923 | 1.400 E | - | - | - |
| 16 | - | - | - | - | - | 3.400 E | 1.015 | 0.904 | 1.280 E | - | - | - |
| 17 | - | - | - | - | - | 4.010 E | 1.006 | 0.873 | 1.170 E | - | - | - |
| 18 | - | - | - | - | - | 4.860 E | 0.970 | 0.864 | 1.070 E | - | - | - |
| 19 | - | - | - | - | - | 5.775 P | 0.999 | 0.825 | 0.980 E | - | - | - |
| 20 | - | - | - | - | - | 6.119 | 0.998 | 0.774 | 0.910 E | - | - | - |
| | | | | | | 6.270 | 0.987 | 0.737 | 0.840 E | - | | |
| 21 | - | - | - | - | - | | | | | | - | - |
| 22 | - | - | - | - | - | 6.090 | 0.907 | 0.720 | 0.770 E | - | - | - |
| 23 | - | - | - | - | - | 5.771 | 0.912 | 0.739 | 0.700 E | - | - | - |
| 24 | - | - | - | - | - | 5.419 | 0.925 | 0.727 | 0.630 E | - | - | - |
| 25 | - | - | - | - | - | 5.011 | 0.891 | 0.739 | 0.560 E | - | - | - |
| 26 | - | - | - | - | - | 4.574 | 1.036 | 0.696 | 0.490 E | - | - | - |
| 27 | - | - | - | - | - | 4.148 | 1.065 | 0.728 | 0.420 E | - | - | - |
| 28 | - | - | - | - | - | 3.775 | 1.075 | 0.754 | 0.350 E | - | - | - |
| 29 | - | - | - | - | - | 3.577 | 1.077 | 0.817 | 0.300 E | - | - | - |
| 30 | - | - | - | - | - | 3.399 | 1.146 | 0.971 | 0.235 E | - | - | - |
| 31 | - | - | - | - | - | - | 1.107 | 1.212 | - | - | - | - |
| MIN | - | - | - | - | - | 0.045 | 0.891 | 0.696 | 0.235 | - | - | - |
| MEAN | - | - | - | - | - | 2.948 | 1.408 | 0.884 | 1.284 | - | - | - |
| MAX | - | - | - | - | - | 6.270 | 3.175 | 1.212 | 2.218 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 6.958 m**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 6.441 | 6.238 | 6.202 | - | - | - |
| 2 | - | - | - | - | - | - | 6.431 | 6.247 | 6.224 | - | - | - |
| 3 | - | - | - | - | - | - | 6.422 | 6.242 | 6.254 | - | - | - |
| 4 | - | - | - | - | - | - | 6.409 | 6.247 | 6.289 | - | - | - |
| 5 | - | - | - | - | | | 6.393 | 6.243 | 6.321 | | - | - |
| 6 | - | - | - | - | - | - | 6.376 | 6.235 | 6.339 | - | - | - |
| 7 | - | - | - | - | - | - | 6.360 | 6.231 | 6.347 | - | - | - |
| 8 | - | - | - | - | - | - | 6.343 | 6.225 | 6.347 | - | - | - |
| 9 | - | - | - | - | - | - | 6.327 | 6.220 | 6.341 | - | - | - |
| 10 | - | - | - | - | | | 6.313 | 6.216 | 6.333 | | - | - |
| 11 | - | - | - | - | - | - | 6.299 | 6.213 | 6.324 | - | - | - |
| 12 | - | - | - | - | - | - | 6.284 | 6.208 | 6.319 P | - | - | - |
| 13 | - | - | - | - | - | - | 6.275 | 6.207 | - | - | - | - |
| 14 | - | - | - | - | - | - | 6.268 | 6.207 | - | - | - | - |
| 15 | - | - | - | - | - | - | 6.259 | 6.215 | - | - | - | - |
| 16 | - | - | - | - | - | - | 6.253 | 6.218 | - | - | - | - |
| 17 | - | - | - | - | - | - | 6.245 | 6.222 | - | - | - | - |
| 18 | - | - | - | - | - | - | 6.238 | 6.218 | - | - | - | - |
| 19 | - | - | - | - | - | - | 6.230 | 6.215 | - | - | - | - |
| 20 | - | - | - | - | - | - | 6.229 | 6.210 | - | - | - | - |
| 21 | - | - | - | - | - | - | 6.224 | 6.209 | - | - | - | - |
| 22 | - | - | - | - | - | 6.526 P | 6.228 | 6.203 | - | - | - | - |
| 23 | - | - | - | - | - | 6.539 | 6.228 | 6.195 | - | - | - | - |
| 24 | - | - | - | - | - | 6.544 | 6.227 | 6.189 | - | - | - | - |
| 25 | - | - | - | - | - | 6.538 | 6.215 | 6.186 | - | - | - | - |
| 26 | - | - | - | - | - | 6.526 | 6.216 | 6.189 | - | - | - | - |
| 27 | - | - | - | - | - | 6.513 | 6.218 | 6.187 | - | - | - | - |
| 28 | - | - | - | - | - | 6.497 | 6.213 | 6.189 | - | - | - | - |
| 29 | - | - | - | - | - | 6.478 | 6.233 | 6.182 | - | - | - | - |
| 30 | - | - | - | - | - | 6.459 | 6.237 | 6.187 | - | - | - | - |
| 31 | - | - | - | - | - | - | 6.238 | 6.192 | - | - | - | - |
| MIN | - | - | - | - | - | 6.459 | 6.213 | 6.182 | 6.202 | - | - | - |
| MEAN | - | - | - | - | - | 6.513 | 6.286 | 6.212 | 6.303 | - | - | - |
| MAX | - | - | - | - | - | 6.544 | 6.441 | 6.247 | 6.347 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Roberts Outflow

LOCATION: Outlet of Roberts Lake

COORDINATES:435289 m E, 7562800 m N (NAD83)

MEASUREMENT DATE: 19 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:15 h

MEASUREMENT END TIME: 13:00 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.0 | | 0.00 | | | 0.00 | |
| 2 | 1.0 | shrubs | 0.19 | | | 0.29 | 0.055 |
| 3 | 2.0 | shrubs | 0.22 | | | 0.34 | 0.075 |
| 4 | 3.0 | shrubs | 0.46 | | | 0.42 | 0.193 |
| 5 | 4.0 | | 0.54 | | | 0.67 | 0.362 |
| 6 | 5.0 | | 0.63 | | | 0.68 | 0.428 |
| 7 | 6.0 | | 0.74 | | | 0.76 | 0.562 |
| 8 | 7.0 | | 0.88 | 0.99 | 0.79 | | 0.783 |
| 9 | 8.0 | | 0.84 | 0.89 | 0.85 | | 0.731 |
| 10 | 9.0 | | 0.86 | 0.96 | 0.88 | | 0.791 |
| 11 | 10.0 | | 0.86 | 0.92 | 0.85 | | 0.761 |
| 12 | 11.0 | | 0.90 | 0.70 | 0.53 | | 0.554 |
| 13 | 12.0 | | 0.66 | | | 0.49 | 0.323 |
| 14 | 13.0 | | 0.13 | | | 0.58 | 0.075 |
| 15 | 14.0 | | 0.48 | | | 0.37 | 0.178 |
| 16 | 15.0 | | 0.46 | | | 0.32 | 0.147 |
| 17 | 16.0 | shrubs | 0.23 | | | 0.12 | 0.028 |
| 18 | 17.0 | shrubs | 0.20 | | | 0.11 | 0.022 |
| 19 | 18.0 | shrubs | 0.09 | | | 0.07 | 0.006 |
| 20 | 19.0 | shrubs | 0.04 | | | 0.00 | 0.000 |
| Right Bank | 20.0 | | 0.00 | | | | |
| | | | | | | | **5.898** |

PROJECT NAME: Hope Bay Project – Doris Area
PROJECT NUMBER: 08-1373-0026.2000
DISCHARGE DATA

STREAM NAME: Roberts Outflow
LOCATION: Outlet of Roberts Lake
COORDINATES:435289 m E, 7562800 m N (NAD83)

MEASUREMENT DATE: 2 July 2008
METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG
COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:15 h
MEASUREMENT END TIME: 13:36 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 15.2 | | 0.00 | | | | 0.000 |
| 2 | 14.5 | | 0.07 | | | 0.30 | 0.013 |
| 3 | 14.0 | | 0.16 | | | 0.41 | 0.033 |
| 4 | 13.5 | | 0.27 | | | 0.32 | 0.043 |
| 5 | 13.0 | | 0.30 | | | 0.53 | 0.080 |
| 6 | 12.5 | | 0.28 | | | 0.63 | 0.088 |
| 7 | 12.0 | | 0.35 | | | 0.93 | 0.163 |
| 8 | 11.5 | | 0.83 | 0.88 | 0.40 | | 0.266 |
| 9 | 11.0 | | 0.81 | 0.62 | 0.50 | | 0.227 |
| 10 | 10.5 | | 0.66 | | | 0.55 | 0.182 |
| 11 | 10.0 | | 0.66 | | | 0.65 | 0.215 |
| 12 | 9.5 | | 0.62 | | | 0.63 | 0.195 |
| 13 | 9.0 | | 0.62 | | | 0.57 | 0.177 |
| 14 | 8.5 | | 0.65 | | | 0.67 | 0.218 |
| 15 | 8.0 | | 0.68 | | | 0.56 | 0.190 |
| 16 | 7.5 | | 0.65 | | | 0.45 | 0.146 |
| 17 | 7.0 | | 0.62 | | | 0.52 | 0.161 |
| 18 | 6.5 | | 0.59 | | | 0.46 | 0.136 |
| 19 | 6.0 | | 0.46 | | | 0.37 | 0.085 |
| 20 | 5.5 | | 0.45 | | | 0.41 | 0.092 |
| 21 | 5.0 | | 0.34 | | | 0.50 | 0.085 |
| 22 | 4.5 | | 0.29 | | | 0.10 | 0.015 |
| 23 | 4.0 | | 0.10 | | | 0.00 | 0.000 |
| Right Bank | 3.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **2.808** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Roberts Outflow

LOCATION: Outlet of Roberts Lake

COORDINATES:435289 m E, 7562800 m N (NAD83)

MEASUREMENT DATE: 9 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:45 h

MEASUREMENT END TIME: 14:05 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.3 | | 0.21 | | | 0.83 | 0.052 |
| 3 | 0.6 | | 0.23 | | | 0.76 | 0.052 |
| 4 | 0.9 | | 0.26 | | | 0.77 | 0.060 |
| 5 | 1.2 | | 0.27 | | | 0.93 | 0.075 |
| 6 | 1.5 | | 0.22 | | | 0.50 | 0.033 |
| 7 | 1.8 | | 0.23 | | | 0.71 | 0.049 |
| 8 | 2.1 | | 0.24 | | | 0.62 | 0.045 |
| 9 | 2.4 | | 0.36 | | | 0.83 | 0.090 |
| 10 | 2.7 | | 0.26 | | | 0.66 | 0.051 |
| 11 | 3.0 | | 0.24 | | | 0.70 | 0.050 |
| 12 | 3.3 | | 0.23 | | | 0.68 | 0.047 |
| 13 | 3.6 | | 0.23 | | | 0.77 | 0.053 |
| 14 | 3.9 | | 0.22 | | | 0.75 | 0.050 |
| 15 | 4.2 | | 0.24 | | | 0.77 | 0.055 |
| 16 | 4.5 | | 0.26 | | | 0.78 | 0.051 |
| 17 | 4.7 | | 0.26 | | | 0.57 | 0.037 |
| Left Bank | 5.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.851** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Roberts Outflow

LOCATION: Outlet of Roberts Lake

COORDINATES:435289 m E, 7562800 m N (NAD83)

MEASUREMENT DATE: 12 Sept 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / DA

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:13 h

MEASUREMENT END TIME: 12:50 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.5 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.5 | | 0.16 | | | 0.00 | 0.000 |
| 3 | 1.7 | | 0.20 | | | 0.12 | 0.006 |
| 4 | 2.0 | | 0.24 | | | 0.31 | 0.030 |
| 5 | 2.5 | | 0.22 | | | 0.73 | 0.080 |
| 6 | 3.0 | | 0.40 | | | 0.78 | 0.156 |
| 7 | 3.5 | | 0.41 | | | 0.78 | 0.160 |
| 8 | 4.0 | | 0.38 | | | 0.91 | 0.173 |
| 9 | 4.5 | | 0.40 | | | 0.71 | 0.142 |
| 10 | 5.0 | | 0.42 | | | 0.83 | 0.174 |
| 11 | 5.5 | | 0.53 | | | 0.81 | 0.215 |
| 12 | 6.0 | | 0.52 | | | 0.59 | 0.153 |
| 13 | 6.5 | | 0.40 | | | 0.79 | 0.158 |
| 14 | 7.0 | | 0.42 | | | 0.73 | 0.153 |
| 15 | 7.5 | | 0.20 | | | 0.63 | 0.063 |
| 16 | 8.0 | | 0.25 | | | 0.29 | 0.036 |
| 17 | 8.5 | | 0.16 | | | 0.26 | 0.027 |
| Left Bank | 9.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.727** |

# LITTLE ROBERTS OUTFLOW HYDROMETRIC STATION

**H73**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on the Little Roberts Outflow, approximately 200 m downstream of the lake.

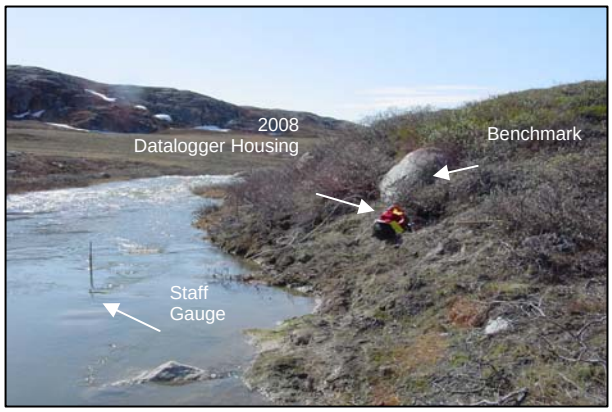
| Operational: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| | 30/6-9/9 | 6/6-7/9 | 28/6-17/9 | 30/5-8/9 | 12/6-14/9 | 19/6-12/9 | |

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 198.9 km$^2$

Coordinates: UTM: 434271 m E, 7563159 m N (Zone 13W NAD83) Lat/Long: 68°10'28" N, 106°35'04" W

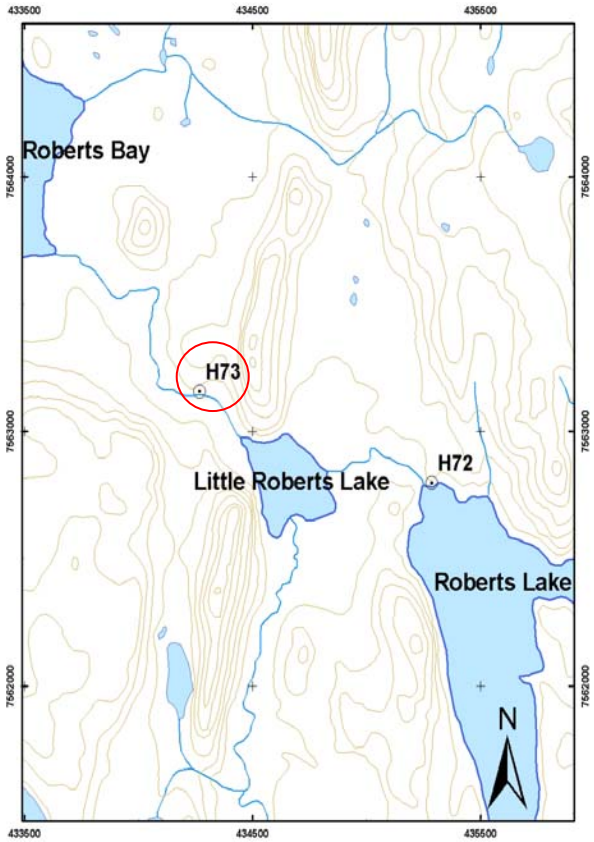
Instruments: Optimum Instruments Datalogger, KPSI Transducer

Panoramic view of H73 from LDB looking west.



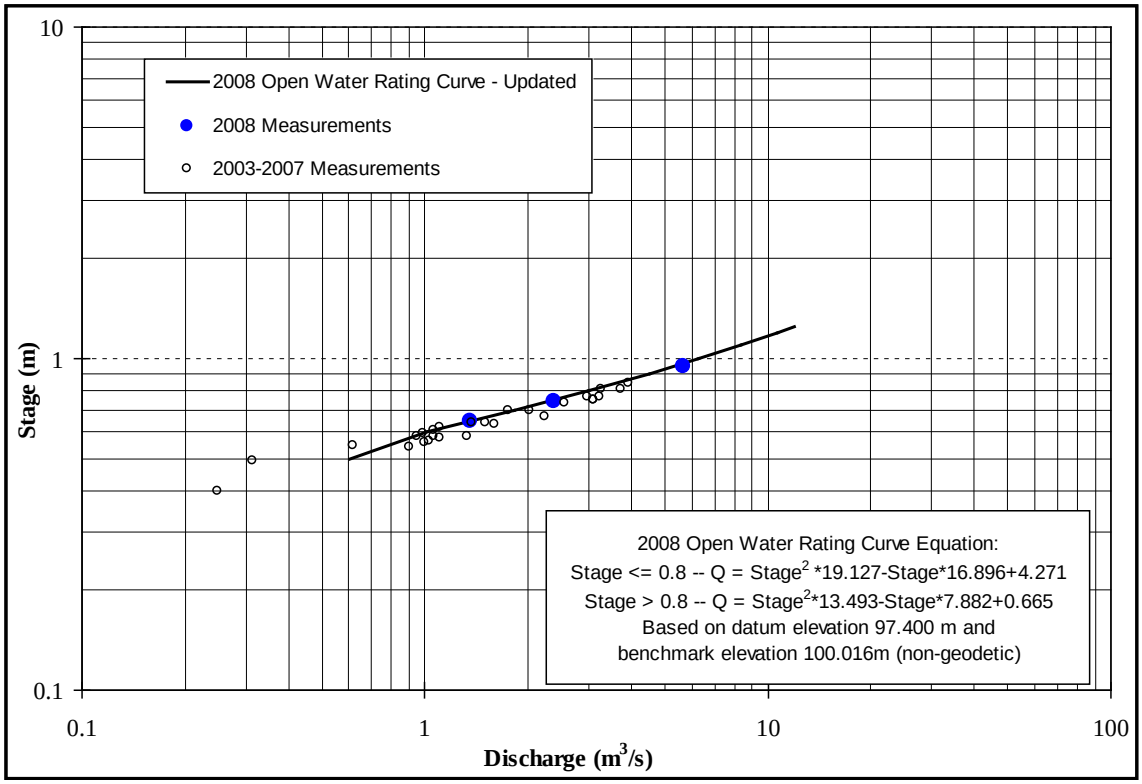

Station H73 from RDB looking downstream.

Station H73 from north bank looking south-east.




NTS Mapping of Area.

FACT-H73-2008.DOC




**Little Roberts Outflow Station H73 – Stage-Discharge Rating Curve (2008)**

**Little Roberts Outflow Station H73 – Stage-Discharge Data (2008)**

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 19-Jun-2008 15:00 | 98.605 | 0.756 | 97.849 | 97.837 | 1.205 | |
| 01-Jul-2008 15:47 | 98.352 | 0.565 | 97.787 | | 0.952 | 5.69 |
| 09-Aug-2008 12:51 | 98.051 | 0.187 | 97.864 | | 0.651 | 1.36 |
| 12-Sep-2008 13:55 | 98.145 | 0.295 | 97.850 | | 0.745 | 2.37 |

## H73 – LITTLE ROBERTS OUTFLOW – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | 0.096 E | 6.383 | 1.615 | 1.892 | 0.571 E | - | - |
| 2 | - | - | - | - | - | 0.132 E | 5.997 | 1.548 | 2.171 | 0.473 E | - | - |
| 3 | - | - | - | - | - | 0.168 E | 5.617 | 1.437 | 2.299 | 0.375 E | - | - |
| 4 | - | - | - | - | - | 0.214 E | 5.245 | 1.384 | 2.376 | 0.312 E | - | - |
| 5 | - | - | - | - | - | 0.260 E | 4.880 | 1.363 | 2.379 | 0.249 E | - | - |
| 6 | - | - | - | - | - | 0.368 E | 4.496 | 1.348 | 2.339 | 0.190 E | - | - |
| 7 | - | - | - | - | - | 0.521 E | 4.163 | 1.289 | 2.272 | 0.153 E | - | - |
| 8 | - | - | - | - | - | 0.781 E | 3.835 | 1.245 | 2.206 | 0.116 E | - | - |
| 9 | - | - | - | - | - | 1.230 E | 3.517 | 1.182 | 2.184 | 0.089 E | - | - |
| 10 | - | - | - | - | - | 1.830 E | 3.238 | 1.150 | 2.237 | 0.062 E | - | - |
| 11 | - | - | - | - | - | 2.540 E | 2.991 | 1.142 | 2.229 | 0.035 E | - | - |
| 12 | - | - | - | - | - | 3.460 E | 2.847 | 1.259 | 2.174 P | 0.008 E | - | - |
| 13 | - | - | - | - | - | 4.440 E | 2.715 | 1.246 | 2.100 E | - | - | - |
| 14 | - | - | - | - | - | 5.500 E | 2.523 | 1.219 | 2.010 E | - | - | - |
| 15 | - | - | - | - | - | 6.700 E | 2.352 | 1.171 | 1.940 E | - | - | - |
| 16 | - | - | - | - | - | 7.680 E | 2.208 | 1.137 | 1.840 E | - | - | - |
| 17 | - | - | - | - | - | 8.610 E | 2.091 | 1.090 | 1.750 E | - | - | - |
| 18 | - | - | - | - | - | 9.600 E | 2.023 | 1.073 | 1.670 E | - | - | - |
| 19 | - | - | - | - | - | 10.330 P | 1.933 | 1.025 | 1.580 E | - | - | - |
| 20 | - | - | - | - | - | 10.803 | 2.009 | 0.971 | 1.480 E | - | - | - |
| 21 | - | - | - | - | - | 11.301 | 1.909 | 0.934 | 1.370 E | - | - | - |
| 22 | - | - | - | - | - | 11.278 | 1.782 | 0.914 | 1.260 E | - | - | - |
| 23 | - | - | - | - | - | 10.838 | 1.696 | 0.939 | 1.200 E | - | - | - |
| 24 | - | - | - | - | - | 10.379 | 1.633 | 0.935 | 1.170 E | - | - | - |
| 25 | - | - | - | - | - | 9.767 | 1.573 | 0.921 | 1.100 E | - | - | - |
| 26 | - | - | - | - | - | 9.049 | 1.842 | 0.885 | 1.030 E | - | - | - |
| 27 | - | - | - | - | - | 8.082 | 1.840 | 0.986 | 0.950 E | - | - | - |
| 28 | - | - | - | - | - | 7.561 | 1.782 | 1.027 | 0.863 E | - | - | - |
| 29 | - | - | - | - | - | 7.173 | 1.741 | 1.091 | 0.767 E | - | - | - |
| 30 | - | - | - | - | 0.022 E | 6.679 | 1.713 | 1.321 | 0.669 E | - | - | - |
| 31 | - | - | - | - | 0.056 E | - | 1.642 | 1.587 | - | - | - | - |
| MIN | - | - | - | - | 0.022 | 0.096 | 1.573 | 0.885 | 0.669 | 0.008 | - | - |
| MEAN | - | - | - | - | 0.039 | 5.579 | 2.910 | 1.175 | 1.717 | 0.219 | - | - |
| MAX | - | - | - | - | 0.056 | 11.301 | 6.383 | 1.615 | 2.379 | 0.571 | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.016 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 98.406 | 98.079 | 98.107 | - | - | - |
| 2 | - | - | - | - | - | - | 98.385 | 98.071 | 98.134 | - | - | - |
| 3 | - | - | - | - | - | - | 98.365 | 98.058 | 98.145 | - | - | - |
| 4 | - | - | - | - | - | - | 98.344 | 98.052 | 98.152 | - | - | - |
| 5 | - | - | - | - | | | 98.323 | 98.049 | 98.152 | | - | - |
| 6 | - | - | - | - | - | - | 98.300 | 98.047 | 98.148 | - | - | - |
| 7 | - | - | - | - | - | - | 98.279 | 98.040 | 98.143 | - | - | - |
| 8 | - | - | - | - | - | - | 98.258 | 98.034 | 98.137 | - | - | - |
| 9 | - | - | - | - | - | - | 98.237 | 98.025 | 98.135 | - | - | - |
| 10 | - | - | - | - | | | 98.217 | 98.020 | 98.140 | | - | - |
| 11 | - | - | - | - | - | - | 98.200 | 98.019 | 98.139 | - | - | - |
| 12 | - | - | - | - | - | - | 98.189 | 98.036 | 98.134 P | - | - | - |
| 13 | - | - | - | - | - | - | 98.179 | 98.034 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.164 | 98.030 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.150 | 98.023 | - | - | - | - |
| 16 | - | - | - | - | - | - | 98.137 | 98.018 | - | - | - | - |
| 17 | - | - | - | - | - | - | 98.126 | 98.011 | - | - | - | - |
| 18 | - | - | - | - | - | - | 98.120 | 98.009 | - | - | - | - |
| 19 | - | - | - | - | - | 98.587 P | 98.111 | 98.001 | - | - | - | - |
| 20 | - | - | - | - | - | 98.608 | 98.119 | 97.992 | - | - | - | - |
| 21 | - | - | - | - | - | 98.589 | 98.109 | 97.985 | - | - | - | - |
| 22 | - | - | - | - | - | 98.564 | 98.097 | 97.982 | - | - | - | - |
| 23 | - | - | - | - | - | 98.533 | 98.088 | 97.986 | - | - | - | - |
| 24 | - | - | - | - | - | 98.489 | 98.081 | 97.985 | - | - | - | - |
| 25 | - | - | - | - | - | 98.464 | 98.074 | 97.983 | - | - | - | - |
| 26 | - | - | - | - | - | 98.445 | 98.103 | 97.976 | - | - | - | - |
| 27 | - | - | - | - | - | 98.421 | 98.102 | 97.994 | - | - | - | - |
| 28 | - | - | - | - | - | 98.406 | 98.096 | 98.001 | - | - | - | - |
| 29 | - | - | - | - | - | 98.385 | 98.092 | 98.011 | - | - | - | - |
| 30 | - | - | - | - | - | 98.365 | 98.089 | 98.043 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.082 | 98.076 | - | - | - | - |
| MIN | - | - | - | - | - | 98.365 | 98.074 | 97.976 | 98.107 | - | - | - |
| MEAN | - | - | - | - | - | 98.488 | 98.181 | 98.022 | 98.139 | - | - | - |
| MAX | - | - | - | - | - | 98.608 | 98.406 | 98.079 | 98.152 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Doris Area
PROJECT NUMBER: 08-1373-0026.2000
DISCHARGE DATA

STREAM NAME: Little Roberts Outflow
LOCATION: Outlet of Little Roberts Lake
COORDINATES:434271 m E, 7563159 m N (NAD83)

MEASUREMENT DATE: 4 July 2008
METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG
COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 16:12 h
MEASUREMENT END TIME: 16:45 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Left Bank | 20.7 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 20.2 | | 0.24 | | | 0.13 | 0.011 |
| 3 | 20.0 | | 0.50 | | | 0.23 | 0.040 |
| 4 | 19.5 | | 0.52 | | | 0.80 | 0.208 |
| 5 | 19.0 | | 0.74 | | | 0.81 | 0.300 |
| 6 | 18.5 | | 0.73 | | | 0.86 | 0.314 |
| 7 | 18.0 | | 0.64 | | | 0.88 | 0.282 |
| 8 | 17.5 | | 0.63 | | | 0.47 | 0.148 |
| 9 | 17.0 | | 0.60 | | | 0.75 | 0.225 |
| 10 | 16.5 | | 0.53 | | | 0.81 | 0.215 |
| 11 | 16.0 | | 0.63 | | | 0.83 | 0.261 |
| 12 | 15.5 | | 0.62 | | | 0.64 | 0.198 |
| 13 | 15.0 | | 0.58 | | | 0.68 | 0.197 |
| 14 | 14.5 | | 0.56 | | | 0.77 | 0.216 |
| 15 | 14.0 | | 0.56 | | | 0.89 | 0.249 |
| 16 | 13.5 | | 0.60 | | | 0.55 | 0.165 |
| 17 | 13.0 | | 0.54 | | | 0.89 | 0.240 |
| 18 | 12.5 | | 0.58 | | | 0.85 | 0.247 |
| 19 | 12.0 | | 0.56 | | | 0.86 | 0.241 |
| 20 | 11.5 | | 0.56 | | | 0.87 | 0.244 |
| 21 | 11.0 | | 0.63 | | | 1.07 | 0.337 |
| 22 | 10.5 | | 0.60 | | | 0.93 | 0.279 |
| 23 | 10.0 | | 0.54 | | | 0.99 | 0.267 |
| 24 | 9.5 | | 0.66 | | | 0.75 | 0.248 |
| 25 | 9.0 | | 0.64 | | | 0.98 | 0.314 |
| 26 | 8.5 | | 0.37 | | | 0.76 | 0.141 |
| 27 | 8.0 | | 0.21 | | | 0.51 | 0.054 |
| 28 | 7.5 | | 0.16 | | | 0.18 | 0.014 |
| 29 | 7.0 | | 0.18 | | | 0.05 | 0.005 |
| 30 | 6.5 | | 0.16 | | | 0.10 | 0.008 |
| 31 | 6.0 | | 0.18 | | | 0.10 | 0.009 |
| 32 | 5.5 | | 0.16 | | | 0.07 | 0.006 |
| 33 | 5.0 | | 0.13 | | | 0.10 | 0.007 |
| Right Bank | 4.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **5.687** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Little Roberts Outflow

LOCATION: Outlet of Little Roberts Lake

COORDINATES: 434271 m E, 7563159 m N (NAD83)

MEASUREMENT DATE: 9 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:51 h

MEASUREMENT END TIME: 13:25 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.5 | | 0.17 | | | 0.02 | 0.002 |
| 3 | 1.0 | | 0.24 | | | 0.24 | 0.029 |
| 4 | 1.5 | | 0.30 | | | 0.25 | 0.038 |
| 5 | 2.0 | | 0.38 | | | 0.27 | 0.051 |
| 6 | 2.5 | | 0.44 | | | 0.27 | 0.059 |
| 7 | 3.0 | | 0.48 | | | 0.25 | 0.060 |
| 8 | 3.5 | | 0.53 | | | 0.26 | 0.069 |
| 9 | 4.0 | | 0.54 | | | 0.31 | 0.084 |
| 10 | 4.5 | | 0.60 | | | 0.30 | 0.090 |
| 11 | 5.0 | | 0.66 | | | 0.24 | 0.079 |
| 12 | 5.5 | | 0.72 | | | 0.36 | 0.130 |
| 13 | 6.0 | | 0.70 | | | 0.04 | 0.014 |
| 14 | 6.5 | | 0.67 | | | 0.36 | 0.121 |
| 15 | 7.0 | | 0.64 | | | 0.45 | 0.144 |
| 16 | 7.5 | | 0.59 | | | 0.54 | 0.159 |
| 17 | 8.0 | | 0.58 | | | 0.40 | 0.116 |
| 18 | 8.5 | | 0.49 | | | 0.27 | 0.066 |
| 19 | 9.0 | | 0.38 | | | 0.19 | 0.029 |
| 20 | 9.3 | | 0.38 | | | 0.13 | 0.017 |
| Left Bank | 9.7 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.356** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Little Roberts Outflow

LOCATION: Outlet of Little Roberts Lake

COORDINATES: 434271 m E, 7563159 m N (NAD83)

MEASUREMENT DATE: 12 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / DA

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:51 h

MEASUREMENT END TIME: 13:25 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 1.0 | | 0.00 | | | 0.00 | |
| 2 | 2.0 | | 0.06 | | | 0.02 | 0.001 |
| 3 | 3.0 | | 0.10 | | | 0.03 | 0.003 |
| 4 | 4.0 | | 0.14 | | | 0.02 | 0.002 |
| 5 | 4.5 | | 0.26 | | | 0.34 | 0.044 |
| 6 | 5.0 | | 0.42 | | | 0.40 | 0.084 |
| 7 | 5.5 | | 0.10 | | | 0.50 | 0.025 |
| 8 | 6.0 | | 0.01 | | | 0.45 | 0.002 |
| 9 | 6.5 | | 0.54 | | | 0.41 | 0.111 |
| 10 | 7.0 | | 0.58 | | | 0.38 | 0.110 |
| 11 | 7.5 | | 0.62 | | | 0.38 | 0.118 |
| 12 | 8.0 | | 0.64 | | | 0.35 | 0.112 |
| 13 | 8.5 | | 0.70 | | | 0.40 | 0.140 |
| 14 | 9.0 | | 0.76 | 0.46 | 0.30 | | 0.144 |
| 15 | 9.5 | | 0.74 | 0.50 | 0.33 | | 0.154 |
| 16 | 10.0 | | 0.82 | 0.52 | 0.40 | | 0.189 |
| 17 | 10.5 | | 0.80 | 0.52 | 0.50 | | 0.204 |
| 18 | 11.0 | | 0.79 | 0.50 | 0.39 | | 0.176 |
| 19 | 11.5 | | 0.76 | 0.57 | 0.53 | | 0.209 |
| 20 | 12.0 | | 0.71 | 0.65 | 0.60 | | 0.222 |
| 21 | 12.5 | | 0.66 | | | 0.51 | 0.168 |
| 22 | 13.0 | | 0.54 | | | 0.34 | 0.092 |
| 23 | 13.5 | | 0.50 | | | 0.26 | 0.046 |
| 24 | 13.7 | | 0.26 | | | 0.12 | 0.009 |
| 25 | 14.1 | | 0.18 | | | 0.01 | 0.001 |
| Left Bank | 14.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **2.365** |

# DORIS LAKE
# HYDROMETRIC STATION

**H 7 4**

**FACTSHEET**

## *LOCATION AND DETAILS*

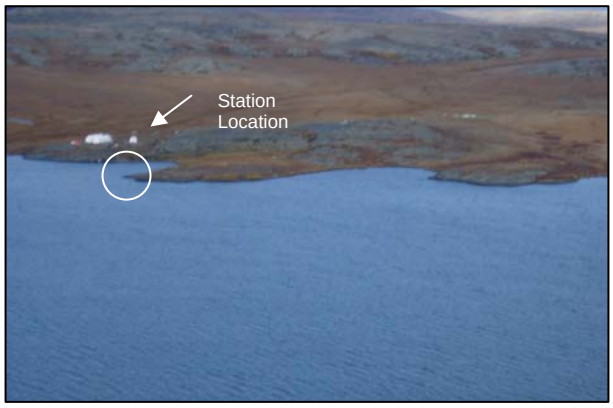
Located on bedrock outcrop on west shore of Doris Lake.

| Operational: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| | n/a | 7/5-10/9 | 22/7-31/12 | 1/1-31/12 | 1/1-31/12 | 1/1-31/12 | |

Benchmark: Rock bolt ; 23.546 m (geodetic) Drainage Area: 93.1 km$^2$

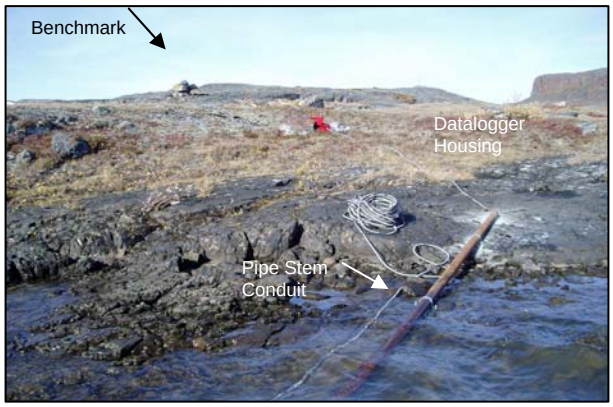
Coordinates: UTM: 433513 m E, 7558451 m N (Zone 13W NAD83) Lat/Long: 68°07'55" N, 106°35'58" W

Instruments: Optimum Instruments Datalogger, KPSI Transducer, Thermistor



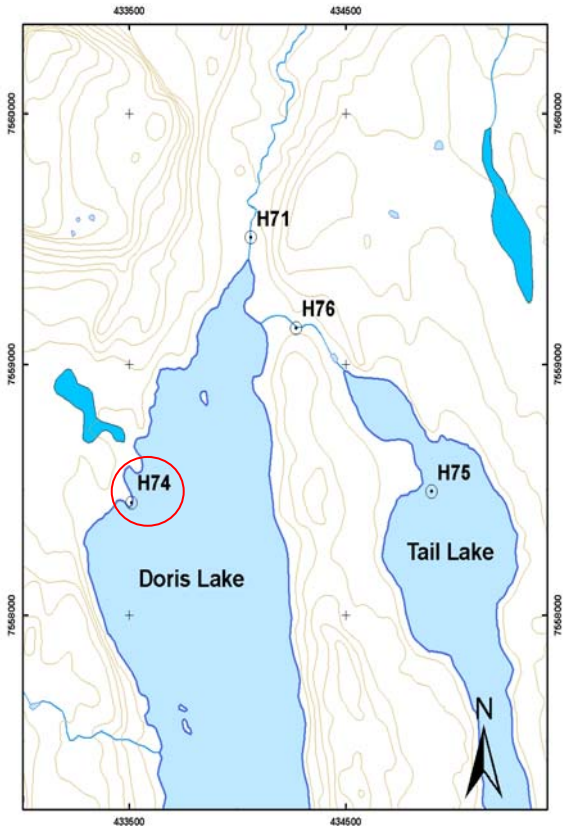

Aerial view of Doris Lake Station H74 looking west.

Station H74 looking southwest.




Station H74 from lake looking northwest.

Station H74 benchmark.




NTS Mapping of Area.

FACT-H74-2008.DOC

# Doris Lake Station H74 – Stage Data (2008)

**Stage Datum** 20.993 m (geodetic)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Water Level (m) |
|---|---|---|---|---|---|
| 01-Jul-2008 09:50 | 21.974 | 6.104 | 15.870 | 15.880 | 21.974 |
| 14-Aug-2008 09:55 | 21.610 | 5.731 | 15.881 | | 21.610 |
| 12-Sep-2008 08:55 | 21.695 | 5.822 | 15.873 | | 21.695 |

## H74 – DORIS LAKE – 2007

MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK EL. 23.546 m

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 21.359 | 21.378 | 21.384 | 21.385 | 21.409 | 21.416 | 2.893 | 21.565 | 21.646 | 21.518 | 21.460 | 21.482 |
| 2 | 21.360 | 21.378 | 21.386 | 21.385 | 21.410 | 21.416 | 2.905 | 21.556 | 21.642 | 21.508 | 21.458 | 21.483 |
| 3 | 21.362 | 21.379 | 21.387 | 21.385 | 21.411 | 21.420 | 2.931 | 21.547 | 21.638 | 21.502 | 21.458 | 21.485 |
| 4 | 21.362 | 21.381 | 21.387 | 21.385 | 21.417 | 21.421 | 2.938 | 21.540 | 21.633 | 21.501 | 21.456 | 21.484 |
| 5 | 21.364 | 21.381 | 21.385 | 21.385 | 21.419 | 21.420 | 3.023 | 21.532 | 21.630 | 21.503 | 21.456 | 21.481 |
| 6 | 21.366 | 21.382 | 21.384 | 21.385 | 21.416 | 21.416 | 3.026 | 21.527 | 21.626 | 21.496 | 21.454 | 21.475 |
| 7 | 21.366 | 21.382 | 21.384 | 21.384 | 21.420 | 21.414 | 3.045 | 21.521 | 21.623 | 21.494 | 21.454 | 21.474 |
| 8 | 21.366 | 21.381 | 21.386 | 21.387 | 21.420 | 21.415 | 3.097 | 21.520 | 21.620 | 21.498 | 21.454 | 21.475 |
| 9 | 21.369 | 21.381 | 21.387 | 21.390 | 21.420 | 21.415 | 3.096 | 21.542 | 21.614 | 21.500 | 21.454 | 21.476 |
| 10 | 21.375 | 21.382 | 21.386 | 21.389 | 21.420 | 21.416 | 3.155 | 21.546 | 21.607 | 21.503 | 21.455 | 21.478 |
| 11 | 21.374 | 21.382 | 21.386 | 21.389 | 21.422 | 21.416 | 3.321 | 21.547 | 21.603 | 21.490 | 21.456 | 21.480 |
| 12 | 21.374 | 21.385 | 21.386 | 21.388 | 21.421 | 21.422 | 3.393 | 21.552 | 21.598 | 21.486 | 21.457 | 21.479 |
| 13 | 21.374 | 21.383 | 21.386 | 21.389 | 21.420 | 21.438 | 3.859 | 21.558 | 21.593 | 21.482 | 21.458 | 21.478 |
| 14 | 21.372 | 21.382 | 21.386 | 21.390 | 21.424 | 21.456 | 4.561 | 21.560 | 21.587 | 21.476 | 21.460 | 21.476 |
| 15 | 21.374 | 21.381 | 21.385 | 21.390 | 21.425 | 21.479 | 4.575 | 21.561 | 21.582 | 21.479 | 21.463 | 21.476 |
| 16 | 21.375 | 21.381 | 21.384 | 21.390 | 21.423 | 21.504 | 5.235 | 21.562 | 21.578 | 21.479 | 21.467 | 21.477 |
| 17 | 21.377 | 21.381 | 21.385 | 21.390 | 21.425 | 21.526 | 4.784 | 21.563 | 21.574 | 21.477 | 21.470 | 21.477 |
| 18 | 21.376 | 21.380 | 21.385 | 21.392 | 21.426 | 21.551 | 6.248 | 21.567 | 21.574 | 21.474 | 21.472 | 21.476 |
| 19 | 21.376 | 21.379 | 21.385 | 21.395 | 21.424 | 21.600 | 5.954 | 21.592 | 21.575 | 21.471 | 21.472 | 21.478 |
| 20 | 21.377 | 21.377 | 21.385 | 21.394 | 21.422 | 21.658 | 8.758 | 21.619 | 21.570 | 21.471 | 21.473 | 21.480 |
| 21 | 21.379 | 21.379 | 21.382 | 21.394 | 21.421 | 21.715 | 9.309 | 21.630 | 21.565 | 21.472 | 21.475 | 21.481 |
| 22 | 21.378 | 21.382 | 21.379 | 21.394 | 21.424 | 21.750 | 6.865 | 21.637 | 21.560 | 21.468 | 21.477 | 21.481 |
| 23 | 21.375 | 21.382 | 21.379 | 21.395 | 21.424 | 21.780 | 8.562 | 21.642 | 21.557 | 21.468 | 21.479 | 21.482 |
| 24 | 21.376 | 21.381 | 21.378 | 21.393 | 21.422 | 21.811 | 8.081 | 21.647 | 21.553 | 21.470 | 21.480 | 21.483 |
| 25 | 21.378 | 21.382 | 21.378 | 21.394 | 21.419 | 21.841 | 8.720 | 21.649 | 21.548 | 21.471 | 21.482 | 21.483 |
| 26 | 21.379 | 21.382 | 21.378 | 21.407 | 21.418 | 21.859 | 8.605 | 21.650 | 21.542 | 21.473 | 21.482 | 21.482 |
| 27 | 21.379 | 21.382 | 21.378 | 21.408 | 21.419 | 21.874 | 9.050 | 21.649 | 21.538 | 21.469 | 21.481 | 21.484 |
| 28 | 21.379 | 21.383 | 21.379 | 21.409 | 21.418 | 21.885 | 9.344 | 21.649 | 21.535 | 21.466 | 21.482 | 21.487 |
| 29 | 21.380 | - | 21.378 | 21.409 | 21.418 | 21.889 | 9.503 | 21.650 | 21.531 | 21.466 | 21.481 | 21.487 |
| 30 | 21.380 | - | 21.378 | 21.409 | 21.417 | 21.888 | 10.355 | 21.649 | 21.523 | 21.465 | - | 21.485 |
| 31 | 21.379 | - | 21.383 | - | 21.416 | - | 10.240 | 21.648 | - | - | | - |
| MIN | 21.36 | 21.38 | 21.38 | 21.38 | 21.41 | 21.41 | 2.89 | 21.52 | 21.52 | 21.46 | 21.45 | 21.47 |
| MEAN | 21.37 | 21.38 | 21.38 | 21.39 | 21.42 | 21.58 | 5.79 | 21.59 | 21.59 | 21.48 | 21.47 | 21.48 |
| MAX | 21.38 | 21.38 | 21.39 | 21.41 | 21.43 | 21.89 | 10.35 | 21.65 | 21.65 | 21.52 | 21.48 | 21.49 |

**MEAN DAILY WATER TEMPERATURE (°C) AT TRANSDUCER**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.28 | 1.32 | 1.37 | 1.40 | 1.48 | 1.54 | 2.89 | 9.99 | 8.29 | 2.16 | 0.88 | 0.85 |
| 2 | 1.27 | 1.33 | 1.35 | 1.40 | 1.49 | 1.54 | 2.90 | 10.12 | 8.13 | 1.39 | 0.88 | 0.85 |
| 3 | 1.27 | 1.34 | 1.37 | 1.41 | 1.49 | 1.54 | 2.93 | 10.25 | 7.90 | 1.49 | 0.89 | 0.85 |
| 4 | 1.26 | 1.35 | 1.38 | 1.41 | 1.49 | 1.54 | 2.94 | 10.57 | 7.79 | 1.45 | 0.88 | 0.84 |
| 5 | 1.27 | 1.33 | 1.37 | 1.41 | 1.49 | 1.55 | 3.02 | 10.61 | 7.64 | 1.15 | 0.88 | 0.84 |
| 6 | 1.29 | 1.34 | 1.38 | 1.42 | 1.49 | 1.56 | 3.03 | 10.57 | 7.55 | 0.97 | 0.88 | 0.86 |
| 7 | 1.29 | 1.35 | 1.38 | 1.43 | 1.49 | 1.56 | 3.04 | 10.54 | 7.51 | 1.07 | 0.88 | 0.90 |
| 8 | 1.31 | 1.36 | 1.38 | 1.44 | 1.50 | 1.56 | 3.10 | 10.40 | 7.18 | 1.04 | 0.87 | 0.90 |
| 9 | 1.32 | 1.35 | 1.38 | 1.44 | 1.50 | 1.57 | 3.10 | 10.21 | 6.90 | 0.99 | 0.87 | 0.88 |
| 10 | 1.32 | 1.36 | 1.37 | 1.45 | 1.50 | 1.57 | 3.16 | 10.03 | 6.62 | 0.91 | 0.86 | 0.86 |
| 11 | 1.34 | 1.35 | 1.35 | 1.46 | 1.51 | 1.59 | 3.32 | 10.04 | 6.15 | 0.82 | 0.86 | 0.87 |
| 12 | 1.34 | 1.35 | 1.35 | 1.46 | 1.51 | 1.65 | 3.39 | 9.92 | 6.05 | 0.86 | 0.85 | 0.86 |
| 13 | 1.33 | 1.34 | 1.35 | 1.46 | 1.51 | 1.67 | 3.86 | 9.98 | 5.85 | 0.75 | 0.85 | 0.85 |
| 14 | 1.32 | 1.36 | 1.37 | 1.47 | 1.51 | 1.71 | 4.56 | 9.96 | 5.54 | 0.77 | 0.85 | 0.87 |
| 15 | 1.34 | 1.35 | 1.37 | 1.47 | 1.52 | 1.78 | 4.57 | 9.83 | 5.11 | 0.80 | 0.85 | 0.88 |
| 16 | 1.34 | 1.35 | 1.35 | 1.47 | 1.52 | 1.84 | 5.23 | 9.81 | 4.91 | 0.82 | 0.85 | 0.89 |
| 17 | 1.33 | 1.36 | 1.33 | 1.45 | 1.52 | 1.88 | 4.78 | 9.83 | 4.66 | 0.85 | 0.85 | 0.91 |
| 18 | 1.34 | 1.35 | 1.35 | 1.46 | 1.52 | 1.91 | 6.25 | 10.01 | 4.43 | 0.85 | 0.85 | 0.92 |
| 19 | 1.33 | 1.36 | 1.35 | 1.46 | 1.52 | 1.97 | 5.95 | 9.77 | 4.24 | 0.86 | 0.86 | 0.91 |
| 20 | 1.32 | 1.37 | 1.36 | 1.47 | 1.52 | 1.99 | 8.76 | 9.69 | 3.90 | 0.84 | 0.86 | 0.91 |
| 21 | 1.32 | 1.37 | 1.36 | 1.47 | 1.52 | 2.01 | 9.31 | 9.64 | 3.19 | 0.86 | 0.85 | 0.89 |
| 22 | 1.31 | 1.36 | 1.35 | 1.47 | 1.52 | 2.09 | 6.87 | 9.53 | 3.41 | 0.86 | 0.85 | 0.93 |
| 23 | 1.30 | 1.35 | 1.35 | 1.47 | 1.51 | 2.14 | 8.56 | 9.45 | 3.57 | 0.85 | 0.85 | 0.92 |
| 24 | 1.30 | 1.35 | 1.36 | 1.47 | 1.52 | 2.26 | 8.08 | 9.23 | 3.40 | 0.87 | 0.85 | 0.92 |
| 25 | 1.31 | 1.34 | 1.37 | 1.47 | 1.52 | 2.31 | 8.72 | 9.03 | 3.26 | 0.87 | 0.84 | 0.91 |
| 26 | 1.31 | 1.35 | 1.38 | 1.47 | 1.53 | 2.36 | 8.61 | 8.91 | 2.99 | 0.87 | 0.84 | 0.91 |
| 27 | 1.29 | 1.36 | 1.37 | 1.47 | 1.53 | 2.46 | 9.05 | 8.77 | 3.07 | 0.89 | 0.84 | 0.89 |
| 28 | 1.29 | 1.38 | 1.38 | 1.47 | 1.53 | 2.61 | 9.34 | 8.57 | 2.83 | 0.89 | 0.86 | 0.89 |
| 29 | 1.30 | - | 1.38 | 1.48 | 1.53 | 2.77 | 9.50 | 8.43 | 2.43 | 0.88 | 0.87 | 0.90 |
| 30 | 1.30 | - | 1.39 | 1.48 | 1.54 | 2.85 | 10.35 | 8.26 | 2.29 | 0.88 | 0.85 | 0.88 |
| 31 | 1.31 | - | 1.40 | - | 1.54 | - | 10.24 | 8.30 | - | 0.88 | - | 0.87 |
| MIN | 1.26 | 1.32 | 1.33 | 1.40 | 1.48 | 1.54 | 2.89 | 8.26 | 2.29 | 0.75 | 0.84 | 0.84 |
| MEAN | 1.31 | 1.35 | 1.37 | 1.45 | 1.51 | 1.91 | 5.79 | 9.69 | 5.23 | 0.98 | 0.86 | 0.88 |
| MAX | 1.34 | 1.38 | 1.40 | 1.48 | 1.54 | 2.85 | 10.35 | 10.61 | 8.29 | 2.16 | 0.89 | 0.93 |

## H74 – DORIS LAKE – 2008

MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK EL. 23.546 m

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 21.490 | 21.503 | 21.506 | 21.512 | 21.521 | 21.577 | 21.992 | 21.689 | 21.625 | - | - | - |
| 2 | 21.488 | 21.502 | 21.507 | 21.512 | 21.520 | 21.583 | 21.969 | 21.686 | 21.646 | - | - | - |
| 3 | 21.485 | 21.502 | 21.505 | 21.512 | 21.520 | 21.602 | 21.951 | 21.671 | 21.659 | - | - | - |
| 4 | 21.485 | 21.504 | 21.506 | 21.512 | 21.520 | 21.611 | 21.944 | 21.670 | 21.668 | - | - | - |
| 5 | 21.485 | 21.502 | 21.508 | 21.512 | 21.521 | 21.617 | 21.917 | 21.668 | 21.675 | - | - | - |
| 6 | 21.483 | 21.502 | 21.506 | 21.511 | 21.521 | 21.623 | 21.902 | 21.662 | 21.680 | - | - | - |
| 7 | 21.485 | 21.502 | 21.505 | 21.511 | 21.521 | 21.633 | 21.885 | 21.653 | 21.685 | - | - | - |
| 8 | 21.486 | 21.503 | 21.505 | 21.511 | 21.521 | 21.635 | 21.863 | 21.636 | 21.688 | - | - | - |
| 9 | 21.489 | 21.502 | 21.506 | 21.509 | 21.521 | 21.634 | 21.856 | 21.636 | 21.693 | - | - | - |
| 10 | 21.491 | 21.501 | 21.506 | 21.506 | 21.520 | 21.727 | 21.844 | 21.615 | 21.703 | - | - | - |
| 11 | 21.492 | 21.504 | 21.506 | 21.507 | 21.520 | 21.838 | 21.827 | 21.623 | 21.709 | - | - | - |
| 12 | 21.492 | 21.508 | 21.506 | 21.509 | 21.519 | 21.883 | 21.822 | 21.643 | 21.711 | - | - | - |
| 13 | 21.491 | 21.509 | 21.506 | 21.507 | 21.518 | 21.907 | 21.809 | 21.621 | - | - | - | - |
| 14 | 21.492 | 21.510 | 21.506 | 21.509 | 21.518 | 21.991 | 21.800 | 21.614 | - | - | - | - |
| 15 | 21.493 | 21.509 | 21.506 | 21.515 | 21.516 | 22.041 | 21.789 | 21.612 | - | - | - | - |
| 16 | 21.493 | 21.509 | 21.507 | 21.516 | 21.512 | 22.042 | 21.771 | 21.607 | - | - | - | - |
| 17 | 21.494 | 21.509 | 21.508 | 21.516 | 21.513 | 21.936 | 21.749 | 21.601 | - | - | - | - |
| 18 | 21.494 | 21.509 | 21.508 | 21.514 | 21.513 | 21.969 | 21.770 | 21.594 | - | - | - | - |
| 19 | 21.498 | 21.506 | 21.510 | 21.515 | 21.515 | 22.100 | 21.749 | 21.587 | - | - | - | - |
| 20 | 21.499 | 21.503 | 21.511 | 21.520 | 21.516 | 22.130 | 21.744 | 21.580 | - | - | - | - |
| 21 | 21.499 | 21.503 | 21.512 | 21.522 | 21.519 | 22.139 | 21.740 | 21.572 | - | - | - | - |
| 22 | 21.498 | 21.502 | 21.513 | 21.520 | 21.521 | 22.139 | 21.745 | 21.566 | - | - | - | - |
| 23 | 21.494 | 21.502 | 21.513 | 21.521 | 21.522 | 22.129 | 21.737 | 21.568 | - | - | - | - |
| 24 | 21.495 | 21.501 | 21.512 | 21.521 | 21.522 | 22.115 | 21.710 | 21.564 | - | - | - | - |
| 25 | 21.495 | 21.502 | 21.511 | 21.521 | 21.523 | 22.099 | 21.722 | 21.561 | - | - | - | - |
| 26 | 21.496 | 21.507 | 21.511 | 21.522 | 21.522 | 22.081 | 21.725 | 21.556 | - | - | - | - |
| 27 | 21.497 | 21.508 | 21.511 | 21.522 | 21.526 | 22.060 | 21.718 | 21.560 | - | - | - | - |
| 28 | 21.498 | 21.507 | 21.511 | 21.522 | 21.538 | 22.040 | 21.715 | 21.561 | - | - | - | - |
| 29 | 21.501 | 21.504 | 21.511 | 21.521 | 21.549 | 22.023 | 21.708 | 21.566 | - | - | - | - |
| 30 | 21.502 | - | 21.512 | 21.521 | 21.562 | 22.009 | 21.689 | 21.583 | - | - | - | - |
| 31 | 21.503 | - | 21.512 | - | 21.573 | - | 21.696 | 21.604 | - | - | | - |
| MIN | 21.48 | 21.50 | 21.50 | 21.51 | 21.51 | 21.58 | 21.69 | 21.56 | 21.63 | - | - | - |
| MEAN | 21.49 | 21.50 | 21.51 | 21.51 | 21.52 | 21.90 | 21.80 | 21.61 | 21.68 | - | - | - |
| MAX | 21.50 | 21.51 | 21.51 | 21.52 | 21.57 | 22.14 | 21.99 | 21.69 | 21.71 | - | - | - |

**MEAN DAILY WATER TEMPERATURE (°C) AT TRANSDUCER**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.89 | 0.92 | 0.91 | 0.97 | 1.18 | 1.65 | 2.55 | 10.57 | 8.71 | - | - | - |
| 2 | 0.92 | 0.92 | 0.91 | 0.98 | 1.19 | 1.66 | 2.66 | 11.40 | 8.62 | - | - | - |
| 3 | 0.94 | 0.93 | 0.91 | 0.98 | 1.20 | 1.66 | 2.73 | 11.39 | 8.53 | - | - | - |
| 4 | 0.93 | 0.92 | 0.90 | 0.98 | 1.21 | 1.65 | 2.75 | 11.15 | 8.42 | - | - | - |
| 5 | 0.94 | 0.91 | 0.93 | 0.98 | 1.22 | 1.66 | 2.89 | 11.13 | 8.22 | - | - | - |
| 6 | 0.93 | 0.91 | 0.93 | 0.99 | 1.23 | 1.67 | 3.07 | 11.14 | 7.95 | - | - | - |
| 7 | 0.92 | 0.91 | 0.92 | 1.00 | 1.25 | 1.70 | 2.88 | 11.09 | 7.66 | - | - | - |
| 8 | 0.92 | 0.91 | 0.92 | 1.01 | 1.25 | 1.74 | 2.85 | 11.00 | 7.40 | - | - | - |
| 9 | 0.90 | 0.92 | 0.91 | 1.02 | 1.26 | 1.80 | 2.97 | 11.11 | 7.15 | - | - | - |
| 10 | 0.91 | 0.92 | 0.90 | 1.02 | 1.28 | 1.90 | 3.76 | 11.43 | 6.92 | - | - | - |
| 11 | 0.91 | 0.92 | 0.90 | 1.04 | 1.30 | 1.96 | 3.63 | 11.67 | 6.69 | - | - | - |
| 12 | 0.92 | 0.94 | 0.88 | 1.05 | 1.31 | 2.04 | 3.20 | 11.43 | 6.46 | - | - | - |
| 13 | 0.90 | 0.94 | 0.88 | 1.06 | 1.33 | 2.01 | 3.39 | 11.27 | - | - | - | - |
| 14 | 0.91 | 0.95 | 0.88 | 1.06 | 1.34 | 2.07 | 3.49 | 11.61 | - | - | - | - |
| 15 | 0.89 | 0.94 | 0.89 | 1.07 | 1.37 | 2.06 | 3.82 | 11.40 | - | - | - | - |
| 16 | 0.89 | 0.95 | 0.89 | 1.08 | 1.38 | 2.08 | 4.27 | 11.33 | - | - | - | - |
| 17 | 0.90 | 0.94 | 0.91 | 1.09 | 1.39 | 2.08 | 4.84 | 11.25 | - | - | - | - |
| 18 | 0.90 | 0.94 | 0.90 | 1.09 | 1.39 | 2.10 | 5.55 | 11.05 | - | - | - | - |
| 19 | 0.91 | 0.93 | 0.91 | 1.10 | 1.40 | 2.09 | 6.03 | 10.85 | - | - | - | - |
| 20 | 0.91 | 0.94 | 0.90 | 1.10 | 1.39 | 2.14 | 6.38 | 10.61 | - | - | - | - |
| 21 | 0.91 | 0.94 | 0.90 | 1.11 | 1.39 | 2.17 | 6.84 | 10.39 | - | - | - | - |
| 22 | 0.91 | 0.93 | 0.89 | 1.12 | 1.43 | 2.21 | 6.64 | 10.33 | - | - | - | - |
| 23 | 0.92 | 0.94 | 0.89 | 1.13 | 1.46 | 2.27 | 7.02 | 10.39 | - | - | - | - |
| 24 | 0.90 | 0.93 | 0.90 | 1.13 | 1.48 | 2.29 | 7.74 | 10.26 | - | - | - | - |
| 25 | 0.90 | 0.93 | 0.94 | 1.13 | 1.51 | 2.31 | 8.31 | 10.12 | - | - | - | - |
| 26 | 0.90 | 0.92 | 0.95 | 1.15 | 1.55 | 2.33 | 7.84 | 9.55 | - | - | - | - |
| 27 | 0.90 | 0.91 | 0.96 | 1.16 | 1.59 | 2.33 | 8.11 | 9.43 | - | - | - | - |
| 28 | 0.92 | 0.91 | 0.96 | 1.16 | 1.61 | 2.34 | 8.29 | 9.22 | - | - | - | - |
| 29 | 0.93 | 0.89 | 0.97 | 1.17 | 1.69 | 2.41 | 8.29 | 8.91 | - | - | - | - |
| 30 | 0.92 | - | 0.97 | 1.18 | 1.66 | 2.48 | 9.30 | 8.79 | - | - | - | - |
| 31 | 0.92 | - | 0.97 | - | 1.65 | - | 9.90 | - | - | - | | - |
| MIN | 0.89 | 0.89 | 0.88 | 0.97 | 1.18 | 1.65 | 2.55 | 8.79 | 6.46 | - | - | - |
| MEAN | 0.91 | 0.93 | 0.92 | 1.07 | 1.38 | 2.03 | 5.23 | 10.71 | 7.73 | - | - | - |
| MAX | 0.94 | 0.95 | 0.97 | 1.18 | 1.69 | 2.48 | 9.90 | 11.67 | 8.71 | - | - | - |

NOTES: D – DERIVED BASED ON DOWNSTREAM DISCHARGES E – ESTIMATED P – PARTIAL DAILY AVERAGE

# TAIL LAKE
# HYDROMETRIC STATION

**H75**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on bedrock outcrop on northwest shore of Tail Lake.

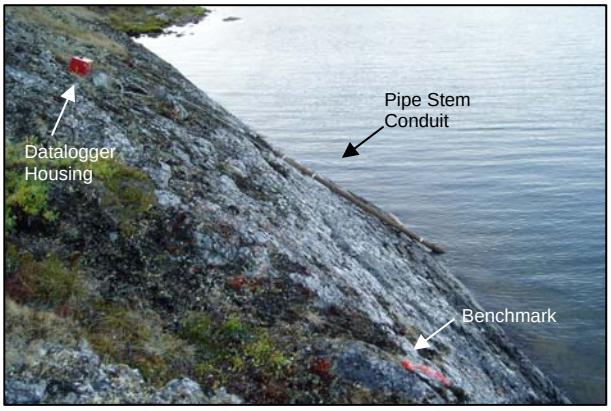
| Operational: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| | n/a | 8/5-31/12 | 1/1-31/12 | 1/1-31/12 | 1/1-31/12 | 1/1-31/12 | |

Benchmark: Rock bolt ; 29.339 m (geodetic) Drainage Area: 4.4 km$^2$

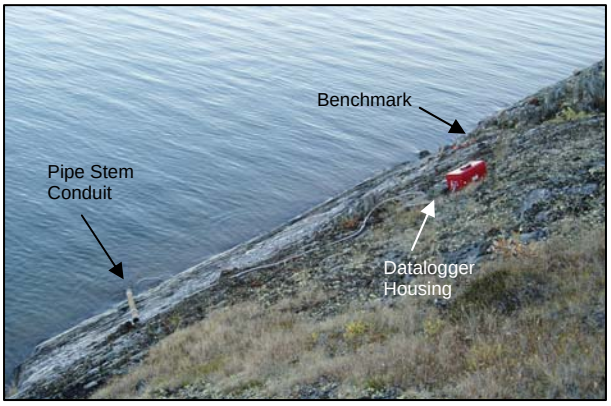
Coordinates: UTM: 434899 m E, 7558494 m N (Zone 13W NAD83) Lat/Long: 68°07'59" N, 106°33'59" W

Instruments: Optimum Instruments Datalogger, KPSI Transducer, Thermistor

Station H75 area looking south along Tail Lake.

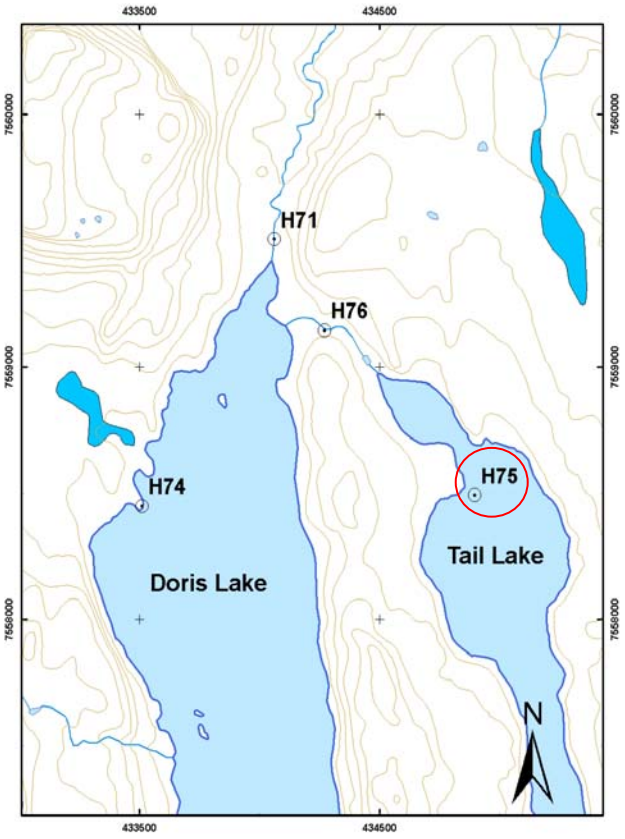



Tail Lake Station H75 looking north.




Tail Lake Station H75 looking east towards water.

Tail Lake Station H75 looking southeast towards water.




NTS Mapping of Area.

## Tail Lake Station H75 – Stage Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Water Level (m) |
|---|---|---|---|---|---|
| 01-Jul-2008 09:50 | 28.353 | 5.084 | 23.269 | 23.268 | 28.353 |
| 09-Aug-2008 16:20 | 28.232 | 4.964 | 23.268 | | 28.232 |
| 12-Sep-2008 09:40 | 28.274 | 5.008 | 23.266 | | 28.274 |

## H75 – TAIL LAKE – 2007

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 29.339 m**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28.137 | 28.149 | 28.149 | 28.145 | 28.174 | 28.177 | 28.347 | 28.179 | 28.241 | 28.203 | 28.222 | 28.225 |
| 2 | 28.136 | 28.149 | 28.150 | 28.145 | 28.174 | 28.178 | 28.338 | 28.175 | 28.238 | 28.201 | 28.222 | 28.225 |
| 3 | 28.136 | 28.150 | 28.152 | 28.144 | 28.177 | 28.178 | 28.332 | 28.170 | 28.235 | 28.195 | 28.223 | 28.225 |
| 4 | 28.137 | 28.151 | 28.152 | 28.143 | 28.179 | 28.177 | 28.327 | 28.166 | 28.233 | 28.200 | 28.224 | 28.223 |
| 5 | 28.138 | 28.151 | 28.149 | 28.142 | 28.179 | 28.177 | 28.321 | 28.162 | 28.231 | 28.202 | 28.224 | 28.218 |
| 6 | 28.140 | 28.151 | 28.148 | 28.141 | 28.177 | 28.176 | 28.314 | 28.161 | 28.230 | 28.198 | 28.224 | 28.218 |
| 7 | 28.142 | 28.150 | 28.148 | 28.140 | 28.182 | 28.175 | 28.308 | 28.159 | 28.229 | 28.198 | 28.224 | 28.217 |
| 8 | 28.144 | 28.149 | 28.149 | 28.143 | 28.182 | 28.175 | 28.302 | 28.162 | 28.229 | 28.205 | 28.224 | 28.217 |
| 9 | 28.148 | 28.149 | 28.150 | 28.147 | 28.183 | 28.175 | 28.296 | 28.186 | 28.227 | 28.208 | 28.224 | 28.217 |
| 10 | 28.152 | 28.150 | 28.150 | 28.147 | 28.182 | 28.175 | 28.291 | 28.194 | 28.227 | 28.210 | 28.224 | 28.217 |
| 11 | 28.152 | 28.150 | 28.149 | 28.149 | 28.181 | 28.176 | 28.284 | 28.197 | 28.229 | 28.205 | 28.225 | 28.218 |
| 12 | 28.152 | 28.148 | 28.148 | 28.152 | 28.181 | 28.184 | 28.274 | 28.203 | 28.228 | 28.205 | 28.224 | 28.217 |
| 13 | 28.152 | 28.148 | 28.148 | 28.153 | 28.181 | 28.211 | 28.269 | 28.210 | 28.226 | 28.204 | 28.223 | 28.216 |
| 14 | 28.150 | 28.148 | 28.149 | 28.154 | 28.182 | 28.239 | 28.263 | 28.214 | 28.228 | 28.202 | 28.224 | 28.215 |
| 15 | 28.150 | 28.149 | 28.148 | 28.155 | 28.183 | 28.267 | 28.258 | 28.215 | 28.228 | 28.203 | 28.225 | 28.216 |
| 16 | 28.150 | 28.150 | 28.147 | 28.155 | 28.183 | 28.291 | 28.253 | 28.216 | 28.227 | 28.207 | 28.227 | 28.216 |
| 17 | 28.150 | 28.150 | 28.147 | 28.155 | 28.183 | 28.305 | 28.246 | 28.216 | 28.223 | 28.208 | 28.227 | 28.215 |
| 18 | 28.150 | 28.149 | 28.147 | 28.155 | 28.183 | 28.311 | 28.241 | 28.219 | 28.220 | 28.207 | 28.226 | 28.214 |
| 19 | 28.151 | 28.149 | 28.146 | 28.154 | 28.181 | 28.316 | 28.237 | 28.242 | 28.219 | 28.206 | 28.226 | 28.213 |
| 20 | 28.151 | 28.149 | 28.146 | 28.154 | 28.181 | 28.322 | 28.232 | 28.268 | 28.218 | 28.208 | 28.225 | 28.214 |
| 21 | 28.151 | 28.149 | 28.146 | 28.154 | 28.180 | 28.328 | 28.226 | 28.272 | 28.216 | 28.213 | 28.225 | 28.215 |
| 22 | 28.151 | 28.149 | 28.145 | 28.154 | 28.180 | 28.333 | 28.219 | 28.271 | 28.214 | 28.212 | 28.226 | 28.219 |
| 23 | 28.150 | 28.149 | 28.145 | 28.154 | 28.179 | 28.333 | 28.214 | 28.268 | 28.214 | 28.214 | 28.227 | 28.214 |
| 24 | 28.150 | 28.148 | 28.143 | 28.154 | 28.179 | 28.342 | 28.212 | 28.265 | 28.213 | 28.220 | 28.226 | 28.219 |
| 25 | 28.150 | 28.149 | 28.143 | 28.158 | 28.178 | 28.356 | 28.210 | 28.261 | 28.212 | 28.221 | 28.226 | 28.220 |
| 26 | 28.150 | 28.149 | 28.144 | 28.171 | 28.178 | 28.360 | 28.206 | 28.256 | 28.210 | 28.221 | 28.226 | 28.220 |
| 27 | 28.150 | 28.148 | 28.143 | 28.173 | 28.179 | 28.361 | 28.201 | 28.251 | 28.208 | 28.221 | 28.225 | 28.220 |
| 28 | 28.150 | 28.148 | 28.144 | 28.174 | 28.180 | 28.362 | 28.196 | 28.249 | 28.207 | 28.222 | 28.225 | 28.220 |
| 29 | 28.150 | - | 28.144 | 28.174 | 28.179 | 28.359 | 28.192 | 28.248 | 28.206 | 28.222 | 28.224 | 28.219 |
| 30 | 28.150 | - | 28.144 | 28.173 | 28.178 | 28.355 | 28.189 | 28.246 | 28.204 | 28.222 | - | 28.219 |
| 31 | 28.150 | - | 28.144 | - | 28.178 | - | 28.184 | 28.244 | - | - | | - |
| MIN | - | - | - | - | - | - | - | - | 28.204 | 28.195 | 28.222 | 28.213 |
| MEAN | - | - | - | - | - | - | - | - | 28.222 | 28.209 | 28.225 | 28.218 |
| MAX | - | - | - | - | - | - | - | - | 28.241 | 28.222 | 28.227 | 28.225 |

**MEAN DAILY WATER TEMPERATURE (°C) AT TRANSDUCER**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 3.38 | 12.36 | 7.38 | 1.69 | 2.15 | 2.23 |
| 2 | - | - | - | - | - | - | 3.44 | 12.08 | 7.26 | 1.48 | 2.15 | 2.22 |
| 3 | - | - | - | - | - | - | 3.50 | 11.99 | 7.00 | 1.51 | 2.15 | 2.22 |
| 4 | - | - | - | - | - | - | 3.60 | 11.98 | 6.71 | 1.62 | 2.15 | 2.22 |
| 5 | - | - | - | - | - | - | 3.75 | 11.72 | 6.53 | 1.58 | 2.15 | 2.22 |
| 6 | - | - | - | - | - | 2.05 | 3.93 | 11.40 | 6.37 | 1.60 | 2.16 | 2.21 |
| 7 | - | - | - | - | - | 2.06 | 4.02 | 11.17 | 6.37 | 1.62 | 2.16 | 2.20 |
| 8 | - | - | - | - | - | 2.07 | 4.13 | 10.85 | 6.08 | 1.65 | 2.16 | 2.20 |
| 9 | - | - | - | - | - | 2.09 | 4.30 | 10.13 | 5.68 | 1.67 | 2.16 | 2.20 |
| 10 | - | - | - | - | - | 2.10 | 4.49 | 9.69 | 5.21 | 1.72 | 2.17 | 2.19 |
| 11 | - | - | - | - | - | 2.13 | 5.36 | 9.51 | 4.82 | 1.79 | 2.18 | 2.19 |
| 12 | - | - | - | - | - | 2.16 | 5.56 | 9.50 | 4.66 | 1.85 | 2.19 | 2.19 |
| 13 | - | - | - | - | - | 2.23 | 5.52 | 9.40 | 4.48 | 1.89 | 2.19 | 2.19 |
| 14 | - | - | - | - | - | 2.29 | 6.18 | 9.51 | 4.06 | 1.93 | 2.19 | 2.19 |
| 15 | - | - | - | - | - | 2.35 | 6.34 | 9.50 | 3.59 | 1.97 | 2.19 | 2.19 |
| 16 | - | - | - | - | - | 2.40 | 6.30 | 9.30 | 3.23 | 2.00 | 2.19 | 2.19 |
| 17 | - | - | - | - | - | 2.45 | 6.43 | 9.22 | 2.86 | 2.01 | 2.19 | 2.19 |
| 18 | - | - | - | - | - | 2.49 | 7.51 | 9.22 | 2.55 | 2.03 | 2.19 | 2.18 |
| 19 | - | - | - | - | - | 2.53 | 7.60 | 9.16 | 2.69 | 2.05 | 2.20 | 2.17 |
| 20 | - | - | - | - | - | 2.59 | 8.64 | 9.05 | 2.88 | 2.05 | 2.20 | 2.16 |
| 21 | - | - | - | - | - | 2.64 | 11.01 | 9.00 | 2.73 | 2.06 | 2.20 | 2.17 |
| 22 | - | - | - | - | - | 2.73 | 11.86 | 8.83 | 2.49 | 2.07 | 2.20 | 2.18 |
| 23 | - | - | - | - | - | 2.83 | 12.67 | 8.61 | 2.60 | 2.07 | 2.21 | 2.17 |
| 24 | - | - | - | - | - | 2.91 | 12.31 | 8.42 | 2.64 | 2.08 | 2.21 | 2.15 |
| 25 | - | - | - | - | - | 2.98 | 12.15 | 8.15 | 2.34 | 2.10 | 2.21 | 2.15 |
| 26 | - | - | - | - | - | 3.07 | 12.08 | 7.93 | 2.14 | 2.10 | 2.22 | 2.14 |
| 27 | - | - | - | - | - | 3.13 | 12.04 | 7.78 | 1.83 | 2.11 | 2.22 | 2.13 |
| 28 | - | - | - | - | - | 3.19 | 11.96 | 7.50 | 1.55 | 2.12 | 2.23 | 2.12 |
| 29 | - | - | - | - | - | 3.25 | 11.97 | 7.33 | 1.47 | 2.13 | 2.23 | 2.11 |
| 30 | - | - | - | - | - | 3.32 | 12.10 | 7.15 | 1.60 | 2.13 | 2.24 | 2.11 |
| 31 | - | - | - | - | - | 3.38 | 12.24 | 7.18 | - | 2.14 | - | 2.11 |
| MIN | - | - | - | - | - | - | 3.38 | 7.15 | 1.47 | 1.48 | 2.15 | 2.11 |
| MEAN | - | - | - | - | - | - | 7.62 | 9.50 | 4.06 | 1.90 | 2.19 | 2.18 |
| MAX | - | - | - | - | - | - | 12.67 | 12.36 | 7.38 | 2.14 | 2.24 | 2.23 |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

## H75 – TAIL LAKE – 2008

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 29.339 m**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 28.221 | 28.233 | 28.236 | 28.243 | 28.255 | 28.298 | 28.365 | 28.278 | 28.314 | - | - | - |
| 2 | 28.221 | 28.234 | 28.236 | 28.244 | 28.255 | 28.297 | 28.359 | 28.272 | 28.321 | - | - | - |
| 3 | 28.220 | 28.234 | 28.236 | 28.244 | 28.256 | 28.319 | 28.354 | 28.266 | 28.319 | - | - | - |
| 4 | 28.220 | 28.235 | 28.237 | 28.243 | 28.256 | 28.320 | 28.348 | 28.264 | 28.312 | - | - | - |
| 5 | 28.220 | 28.234 | 28.236 | 28.242 | 28.257 | 28.318 | 28.343 | 28.263 | 28.305 | - | - | - |
| 6 | 28.219 | 28.235 | 28.236 | 28.240 | 28.256 | 28.324 | 28.338 | 28.259 | 28.299 | - | - | - |
| 7 | 28.221 | 28.235 | 28.236 | 28.240 | 28.256 | 28.332 | 28.333 | 28.254 | 28.292 | - | - | - |
| 8 | 28.222 | 28.235 | 28.236 | 28.240 | 28.256 | 28.335 | 28.328 | 28.250 | 28.289 | - | - | - |
| 9 | 28.222 | 28.235 | 28.238 | 28.238 | 28.255 | 28.340 | 28.324 | 28.247 | 28.287 | - | - | - |
| 10 | 28.223 | 28.234 | 28.239 | 28.238 | 28.254 | 28.351 | 28.318 | 28.244 | 28.290 | - | - | - |
| 11 | 28.223 | 28.235 | 28.239 | 28.239 | 28.254 | 28.357 | 28.312 | 28.247 | 28.291 | - | - | - |
| 12 | 28.223 | 28.236 | 28.240 | 28.240 | 28.253 | 28.358 | 28.311 | 28.256 | 28.288 P | - | - | - |
| 13 | 28.222 | 28.236 | 28.239 | 28.240 | 28.253 | 28.375 | 28.311 | 28.258 | - | - | - | - |
| 14 | 28.225 | 28.236 | 28.240 | 28.244 | 28.253 | 28.416 | 28.306 | 28.257 | - | - | - | - |
| 15 | 28.224 | 28.236 | 28.241 | 28.245 | 28.252 | 28.417 | 28.301 | 28.255 | - | - | - | - |
| 16 | 28.223 | 28.235 | 28.240 | 28.247 | 28.251 | 28.409 | 28.296 | 28.253 | - | - | - | - |
| 17 | 28.227 | 28.235 | 28.241 | 28.248 | 28.251 | 28.406 | 28.292 | 28.249 | - | - | - | - |
| 18 | 28.226 | 28.235 | 28.242 | 28.254 | 28.252 | 28.413 | 28.292 | 28.247 | - | - | - | - |
| 19 | 28.227 | 28.234 | 28.243 | 28.254 | 28.254 | 28.410 | 28.295 | 28.243 | - | - | - | - |
| 20 | 28.228 | 28.233 | 28.242 | 28.256 | 28.256 | 28.413 | 28.294 | 28.239 | - | - | - | - |
| 21 | 28.227 | 28.233 | 28.242 | 28.255 | 28.256 | 28.410 | 28.290 | 28.235 | - | - | - | - |
| 22 | 28.227 | 28.233 | 28.242 | 28.254 | 28.256 | 28.402 | 28.286 | 28.233 | - | - | - | - |
| 23 | 28.225 | 28.233 | 28.242 | 28.255 | 28.256 | 28.394 | 28.280 | 28.238 | - | - | - | - |
| 24 | 28.227 | 28.233 | 28.241 | 28.256 | 28.257 | 28.388 | 28.275 | 28.238 | - | - | - | - |
| 25 | 28.227 | 28.233 | 28.240 | 28.258 | 28.256 | 28.384 | 28.276 | 28.236 | - | - | - | - |
| 26 | 28.228 | 28.233 | 28.241 | 28.258 | 28.261 | 28.378 | 28.292 | 28.233 | - | - | - | - |
| 27 | 28.230 | 28.234 | 28.241 | 28.258 | 28.272 | 28.372 | 28.292 | 28.245 | - | - | - | - |
| 28 | 28.231 | 28.235 | 28.241 | 28.257 | 28.287 | 28.367 | 28.289 | 28.252 | - | - | - | - |
| 29 | 28.232 | 28.235 | 28.241 | 28.256 | 28.295 | 28.367 | 28.287 | 28.262 | - | - | - | - |
| 30 | 28.234 | - | 28.242 | 28.255 | 28.306 | 28.367 | 28.285 | 28.280 | - | - | - | - |
| 31 | 28.234 | - | 28.243 | - | 28.308 | - | 28.280 | 28.298 | - | - | | - |
| MIN | 28.219 | 28.233 | 28.236 | 28.238 | 28.251 | 28.297 | 28.275 | 28.233 | 28.287 | - | - | - |
| MEAN | 28.225 | 28.234 | 28.240 | 28.248 | 28.261 | 28.368 | 28.308 | 28.253 | 28.301 | - | - | - |
| MAX | 28.234 | 28.236 | 28.243 | 28.258 | 28.308 | 28.417 | 28.365 | 28.298 | 28.321 | - | - | - |

**MEAN DAILY WATER TEMPERATURE (°C) AT TRANSDUCER**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.10 | 1.91 | 1.71 | 1.64 | 1.74 | 2.54 | 3.30 | 12.18 | 7.30 | - | - | - |
| 2 | 2.10 | 1.91 | 1.71 | 1.65 | 1.75 | 2.54 | 3.36 | 13.09 | 7.33 | - | - | - |
| 3 | 2.09 | 1.89 | 1.69 | 1.66 | 1.78 | 2.53 | 3.40 | 13.36 | 7.23 | - | - | - |
| 4 | 2.08 | 1.89 | 1.69 | 1.66 | 1.80 | 2.52 | 3.42 | 13.33 | 7.21 | - | - | - |
| 5 | 2.07 | 1.88 | 1.68 | 1.66 | 1.82 | 2.53 | 3.46 | 13.24 | 7.00 | - | - | - |
| 6 | 2.07 | 1.87 | 1.67 | 1.66 | 1.84 | 2.53 | 3.52 | 13.02 | 6.59 | - | - | - |
| 7 | 2.07 | 1.87 | 1.67 | 1.66 | 1.87 | 2.55 | 3.58 | 12.49 | 6.29 | - | - | - |
| 8 | 2.07 | 1.86 | 1.67 | 1.66 | 1.89 | 2.57 | 3.57 | 11.98 | 5.91 | - | - | - |
| 9 | 2.07 | 1.85 | 1.67 | 1.67 | 1.91 | 2.59 | 3.73 | 11.94 | 5.59 | - | - | - |
| 10 | 2.06 | 1.84 | 1.66 | 1.67 | 1.93 | 2.60 | 4.18 | 11.89 | 5.35 | - | - | - |
| 11 | 2.05 | 1.83 | 1.65 | 1.67 | 1.96 | 2.63 | 4.99 | 11.98 | 5.08 | - | - | - |
| 12 | 2.04 | 1.83 | 1.64 | 1.67 | 1.99 | 2.70 | 5.61 | 11.80 | 4.881 P | - | - | - |
| 13 | 2.03 | 1.82 | 1.63 | 1.67 | 2.03 | 2.73 | 5.86 | 11.45 | - | - | - | - |
| 14 | 2.01 | 1.82 | 1.63 | 1.66 | 2.07 | 2.75 | 6.76 | 11.37 | - | - | - | - |
| 15 | 2.01 | 1.80 | 1.64 | 1.66 | 2.12 | 2.77 | 7.35 | 11.22 | - | - | - | - |
| 16 | 2.01 | 1.79 | 1.64 | 1.67 | 2.16 | 2.78 | 7.66 | 11.22 | - | - | - | - |
| 17 | 2.00 | 1.79 | 1.64 | 1.67 | 2.19 | 2.79 | 8.08 | 11.13 | - | - | - | - |
| 18 | 1.98 | 1.78 | 1.64 | 1.67 | 2.20 | 2.81 | 8.61 | 10.63 | - | - | - | - |
| 19 | 1.97 | 1.77 | 1.64 | 1.67 | 2.20 | 2.85 | 8.94 | 10.35 | - | - | - | - |
| 20 | 1.95 | 1.77 | 1.65 | 1.68 | 2.25 | 2.88 | 9.15 | 9.84 | - | - | - | - |
| 21 | 1.94 | 1.76 | 1.65 | 1.68 | 2.28 | 2.95 | 9.92 | 9.49 | - | - | - | - |
| 22 | 1.94 | 1.75 | 1.65 | 1.68 | 2.33 | 3.03 | 10.09 | 9.30 | - | - | - | - |
| 23 | 1.94 | 1.73 | 1.65 | 1.69 | 2.32 | 3.07 | 10.41 | 9.35 | - | - | - | - |
| 24 | 1.93 | 1.73 | 1.65 | 1.69 | 2.35 | 3.09 | 10.59 | 9.31 | - | - | - | - |
| 25 | 1.92 | 1.73 | 1.65 | 1.70 | 2.40 | 3.11 | 10.95 | 9.20 | - | - | - | - |
| 26 | 1.92 | 1.73 | 1.65 | 1.70 | 2.45 | 3.13 | 10.71 | 8.60 | - | - | - | - |
| 27 | 1.92 | 1.74 | 1.65 | 1.71 | 2.45 | 3.16 | 10.64 | 8.15 | - | - | - | - |
| 28 | 1.92 | 1.73 | 1.65 | 1.72 | 2.46 | 3.18 | 10.59 | 8.00 | - | - | - | - |
| 29 | 1.91 | 1.72 | 1.65 | 1.72 | 2.57 | 3.21 | 10.47 | 7.61 | - | - | - | - |
| 30 | 1.91 | - | 1.65 | 1.73 | 2.56 | 3.25 | 10.85 | 7.37 | - | - | - | - |
| 31 | 1.91 | - | 1.64 | - | 2.53 | - | 11.54 | - | - | - | | - |
| MIN | 1.906 | 1.719 | 1.628 | 1.643 | 1.743 | 2.524 | 3.303 | 7.371 | 4.881 | - | - | - |
| MEAN | 1.999 | 1.806 | 1.657 | 1.677 | 2.135 | 2.812 | 7.268 | 10.796 | 6.313 | - | - | - |
| MAX | 2.103 | 1.910 | 1.711 | 1.735 | 2.566 | 3.246 | 11.537 | 13.359 | 7.329 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE

# TAIL OUTFLOW HYDROMETRIC STATION

**H76**

**FACTSHEET**

## *LOCATION AND PURPOSE*

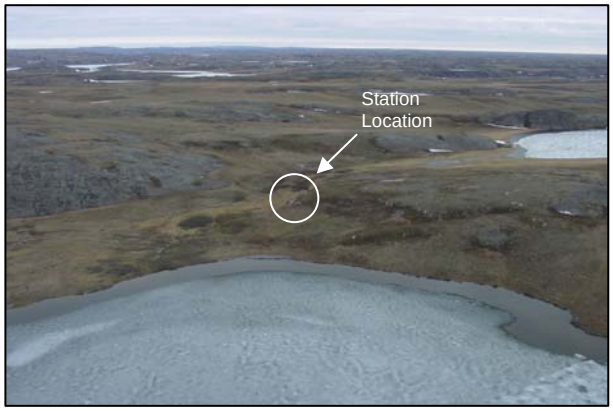
Located on the left downstream bank of Tail Outflow, approximately 200 m upstream of Doris Lake.

| Operational: | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|---|---|---|
| | n/a | 20/6-11/9 | 26/6-17/9 | 26/6-8/9 | 23/6-14/9 | 22/6-12/9 | |

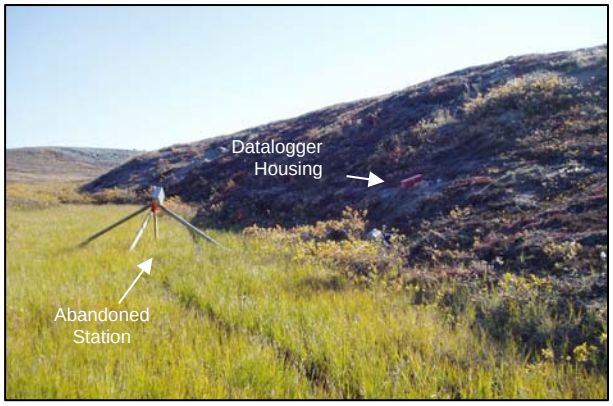
Benchmark: Top of embedded boulder; 26.301 m (geodetic) Drainage Area: 4.4 km$^2$

Coordinates: UTM: 434273 m E, 7559147 m N (Zone 13W NAD83) Lat/Long: 68°08'20" N, 106°34'54" W

Instruments: Optimum Instruments Datalogger, KPSI Transducer



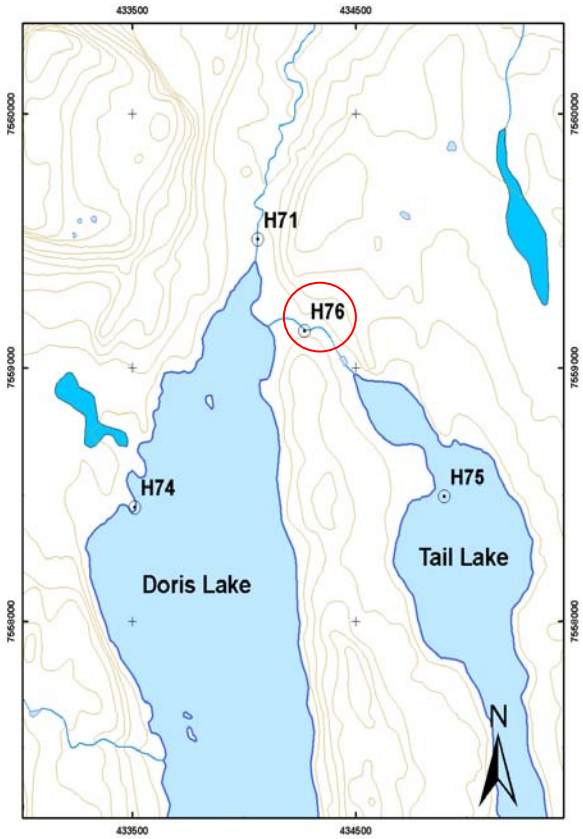

Aerial view of Tail Creek looking upstream from Doris to Tail Lake.



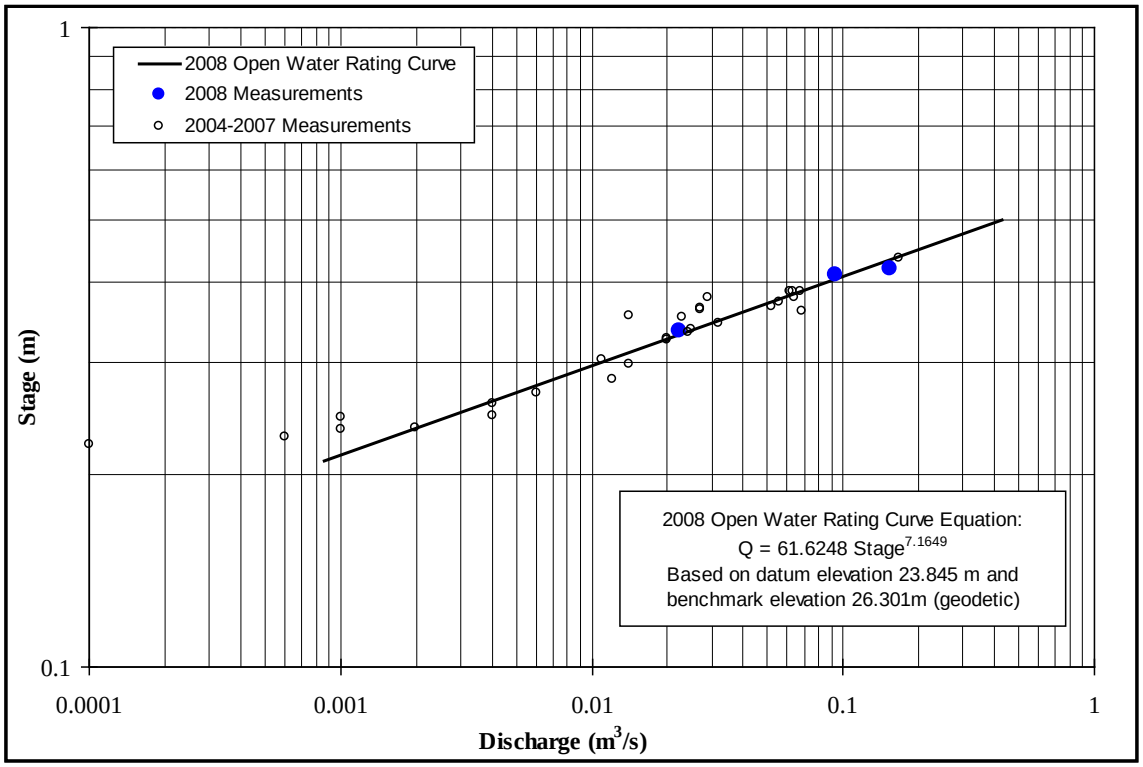

Tail Creek looking east at Station H76.

Station H76 looking west (downstream) during high water.

Station H76 looking east (upstream) during high water.




NTS Mapping of Area.




**Tail Outflow Station H76 – Stage-Discharge Rating Curve (2008)**

## Tail Outflow Station H76 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 22-Jun-2008 14:05 | 24.265 | 0.416 | 23.849 | 23.852 | 0.420 | 0.153 |
| 01-Jul-2008 11:05 | 24.255 | 0.401 | 23.854 | | 0.410 | 0.092 |
| 09-Aug-2008 16:04 | 24.181 | 0.327 | 23.854 | | 0.336 | 0.022 |
| 12-Sep-2008 10:15 | | 0.340 | | | | 0.067 |

## H76 – TAIL OUTFLOW – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 0.099 | 0.053 | 0.186 | 0.015 E | - | - |
| 2 | - | - | - | - | - | - | 0.095 | 0.048 | 0.200 | 0.013 E | - | - |
| 3 | - | - | - | - | - | 0.004 E | 0.090 | 0.041 | 0.185 | 0.011 E | - | - |
| 4 | - | - | - | - | - | 0.009 E | 0.085 | 0.038 | 0.157 | 0.009 E | - | - |
| 5 | - | - | - | - | - | 0.018 E | 0.080 | 0.037 | 0.130 | 0.007 E | - | - |
| 6 | - | - | - | - | - | 0.028 E | 0.077 | 0.033 | 0.109 | 0.005 E | - | - |
| 7 | - | - | - | - | - | 0.038 E | 0.074 | 0.029 | 0.092 | 0.003 E | - | - |
| 8 | - | - | - | - | - | 0.048 E | 0.069 | 0.026 | 0.082 | 0.001 E | - | - |
| 9 | - | - | - | - | - | 0.059 E | 0.065 | 0.025 | 0.078 | - | - | - |
| 10 | - | - | - | - | - | 0.069 E | 0.063 | 0.024 | 0.088 | - | - | - |
| 11 | - | - | - | - | - | 0.079 E | 0.061 | 0.026 | 0.088 | - | - | - |
| 12 | - | - | - | - | - | 0.089 E | 0.058 | 0.031 | 0.080 P | - | - | - |
| 13 | - | - | - | - | - | 0.098 E | 0.057 | 0.033 | 0.075 E | - | - | - |
| 14 | - | - | - | - | - | 0.107 E | 0.053 | 0.034 | 0.071 E | - | - | - |
| 15 | - | - | - | - | - | 0.116 E | 0.049 | 0.030 | 0.067 E | - | - | - |
| 16 | - | - | - | - | - | 0.123 E | 0.046 | 0.029 | 0.063 E | - | - | - |
| 17 | - | - | - | - | - | 0.129 E | 0.045 | 0.026 | 0.059 E | - | - | - |
| 18 | - | - | - | - | - | 0.134 E | 0.047 | 0.025 | 0.055 E | - | - | - |
| 19 | - | - | - | - | - | 0.132 E | 0.048 | 0.022 | 0.051 E | - | - | - |
| 20 | - | - | - | - | - | 0.135 E | 0.047 | 0.020 | 0.046 E | - | - | - |
| 21 | - | - | - | - | - | 0.132 E | 0.049 | 0.017 | 0.041 E | - | - | - |
| 22 | - | - | - | - | - | 0.132 P | 0.045 | 0.017 | 0.036 E | - | - | - |
| 23 | - | - | - | - | - | 0.123 | 0.039 | 0.021 | 0.032 E | - | - | - |
| 24 | - | - | - | - | - | 0.116 | 0.039 | 0.020 | 0.029 E | - | - | - |
| 25 | - | - | - | - | - | 0.108 | 0.040 | 0.019 | 0.027 E | - | - | - |
| 26 | - | - | - | - | - | 0.103 | 0.056 | 0.016 | 0.025 E | - | - | - |
| 27 | - | - | - | - | - | 0.097 | 0.058 | 0.026 | 0.023 E | - | - | - |
| 28 | - | - | - | - | - | 0.096 | 0.056 | 0.029 | 0.021 E | - | - | - |
| 29 | - | - | - | - | - | 0.097 | 0.055 | 0.045 | 0.019 E | - | - | - |
| 30 | - | - | - | - | - | 0.100 | 0.055 | 0.092 | 0.017 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.052 | 0.144 | - | - | - | - |
| MIN | - | - | - | - | - | 0.004 | 0.039 | 0.016 | 0.017 | - | - | - |
| MEAN | - | - | - | - | - | 0.090 | 0.060 | 0.035 | 0.074 | - | - | - |
| MAX | - | - | - | - | - | 0.135 | 0.099 | 0.144 | 0.200 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 26.301 m**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 24.252 | 24.218 | 24.289 | - | - | - |
| 2 | - | - | - | - | - | - | 24.250 | 24.213 | 24.294 | - | - | - |
| 3 | - | - | - | - | - | - | 24.247 | 24.205 | 24.290 | - | - | - |
| 4 | - | - | - | - | - | - | 24.244 | 24.202 | 24.279 | - | - | - |
| 5 | - | - | - | - | - | | 24.241 | 24.200 | 24.268 | - | - | - |
| 6 | - | - | - | - | - | - | 24.239 | 24.195 | 24.258 | - | - | - |
| 7 | - | - | - | - | - | - | 24.236 | 24.188 | 24.248 | - | - | - |
| 8 | - | - | - | - | - | - | 24.232 | 24.184 | 24.242 | - | - | - |
| 9 | - | - | - | - | - | - | 24.229 | 24.181 | 24.239 | - | - | - |
| 10 | - | - | - | - | - | | 24.227 | 24.180 | 24.246 | - | - | - |
| 11 | - | - | - | - | - | - | 24.225 | 24.183 | 24.246 | - | - | - |
| 12 | - | - | - | - | - | - | 24.223 | 24.192 | 24.240 P | - | - | - |
| 13 | - | - | - | - | - | - | 24.222 | 24.194 | - | - | - | - |
| 14 | - | - | - | - | - | - | 24.218 | 24.196 | - | - | - | - |
| 15 | - | - | - | - | - | - | 24.214 | 24.190 | - | - | - | - |
| 16 | - | - | - | - | - | - | 24.211 | 24.188 | - | - | - | - |
| 17 | - | - | - | - | - | - | 24.210 | 24.182 | - | - | - | - |
| 18 | - | - | - | - | - | - | 24.212 | 24.181 | - | - | - | - |
| 19 | - | - | - | - | - | - | 24.214 | 24.175 | - | - | - | - |
| 20 | - | - | - | - | - | - | 24.213 | 24.170 | - | - | - | - |
| 21 | - | - | - | - | - | - | 24.214 | 24.164 | - | - | - | - |
| 22 | - | - | - | - | - | 24.269 P | 24.210 | 24.164 | - | - | - | - |
| 23 | - | - | - | - | - | 24.265 | 24.203 | 24.172 | - | - | - | - |
| 24 | - | - | - | - | - | 24.262 | 24.202 | 24.170 | - | - | - | - |
| 25 | - | - | - | - | - | 24.257 | 24.204 | 24.168 | - | - | - | - |
| 26 | - | - | - | - | - | 24.255 | 24.222 | 24.162 | - | - | - | - |
| 27 | - | - | - | - | - | 24.251 | 24.223 | 24.183 | - | - | - | - |
| 28 | - | - | - | - | - | 24.251 | 24.221 | 24.188 | - | - | - | - |
| 29 | - | - | - | - | - | 24.251 | 24.220 | 24.208 | - | - | - | - |
| 30 | - | - | - | - | - | 24.253 | 24.220 | 24.247 | - | - | - | - |
| 31 | - | - | - | - | - | - | 24.218 | 24.274 | - | - | - | - |
| MIN | - | - | - | - | - | 24.251 | 24.202 | 24.162 | 24.239 | - | - | - |
| MEAN | - | - | - | - | - | 24.257 | 24.223 | 24.191 | 24.262 | - | - | - |
| MAX | - | - | - | - | - | 24.269 | 24.252 | 24.274 | 24.294 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Tail Outflow

LOCATION: Outlet of Tail Lake

COORDINATES: 434273 m E, 7559147 m N (NAD83)

MEASUREMENT DATE: 22 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME:1315 h

MEASUREMENT END TIME:14:15 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.01 | | | 0.00 | 0.000 |
| 2 | 2.0 | | 0.06 | | | 0.00 | 0.000 |
| 3 | 4.0 | | 0.06 | | | 0.00 | 0.000 |
| 4 | 6.0 | | 0.14 | | | 0.01 | 0.003 |
| 5 | 8.0 | | 0.12 | | | 0.02 | 0.004 |
| 6 | 9.0 | | 0.11 | | | 0.15 | 0.017 |
| 7 | 10.0 | | 0.08 | | | 0.02 | 0.002 |
| 8 | 12.0 | | 0.02 | | | 0.00 | 0.000 |
| 9 | 14.0 | | 0.08 | | | 0.00 | 0.000 |
| 10 | 16.0 | | 0.03 | | | 0.00 | 0.000 |
| 11 | 18.0 | | 0.10 | | | 0.01 | 0.002 |
| 12 | 20.0 | | 0.10 | | | 0.03 | 0.005 |
| 13 | 21.0 | | 0.14 | | | 0.04 | 0.004 |
| 14 | 21.5 | | 0.14 | | | 0.13 | 0.009 |
| 15 | 22.0 | | 0.27 | | | 0.44 | 0.059 |
| 16 | 22.5 | | 0.29 | | | 0.26 | 0.038 |
| 17 | 23.0 | | 0.20 | | | 0.07 | 0.007 |
| 18 | 23.5 | | 0.14 | | | 0.05 | 0.004 |
| 19 | 24.0 | | 0.08 | | | 0.01 | 0.000 |
| Left Bank | 24.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.153** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Tail Outflow

LOCATION: Outlet of Tail Lake

COORDINATES: 434273 m E, 7559147 m N (NAD83)

MEASUREMENT DATE: 2 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:55 h

MEASUREMENT END TIME: 13:24 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.5 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.6 | | 0.05 | | | 0.00 | 0.000 |
| 3 | 0.7 | | 0.08 | | | 0.16 | 0.001 |
| 4 | 0.8 | | 0.11 | | | 0.20 | 0.002 |
| 5 | 0.9 | | 0.16 | | | 0.27 | 0.004 |
| 6 | 1.0 | | 0.16 | | | 0.23 | 0.004 |
| 7 | 1.1 | | 0.14 | | | 0.41 | 0.006 |
| 8 | 1.2 | | 0.15 | | | 0.77 | 0.012 |
| 9 | 1.3 | | 0.26 | | | 0.82 | 0.021 |
| 10 | 1.4 | | 0.32 | | | 0.75 | 0.024 |
| 11 | 1.5 | | 0.30 | | | 0.39 | 0.012 |
| 12 | 1.6 | | 0.24 | | | 0.11 | 0.003 |
| 13 | 1.7 | | 0.22 | | | 0.07 | 0.002 |
| 14 | 1.8 | | 0.17 | | | 0.05 | 0.001 |
| 15 | 2.0 | | 0.13 | | | 0.02 | 0.001 |
| 16 | 2.2 | | 0.13 | | | 0.01 | 0.000 |
| 17 | 2.4 | | 0.12 | | | 0.01 | 0.000 |
| Left Bank | 2.9 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.092** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Tail Outflow

LOCATION: Outlet of Tail Lake

COORDINATES: 434273 m E, 7559147 m N (NAD83)

MEASUREMENT DATE: 9 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 15:45 h

MEASUREMENT END TIME: 16:00 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.2 | | 0.17 | | | 0.10 | 0.003 |
| 3 | 0.4 | | 0.27 | | | 0.39 | 0.018 |
| 4 | 0.5 | | 0.17 | | | 0.03 | 0.001 |
| Left Bank | 0.7 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.022** |

PROJECT NAME: Hope Bay Project – Doris Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Tail Outflow

LOCATION: Outlet of Tail Lake

COORDINATES: 434273 m E, 7559147 m N (NAD83)

MEASUREMENT DATE: 12 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / DA

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 10:18 h

MEASUREMENT END TIME: 10:45 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.6 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.8 | | 0.10 | | | 0.17 | 0.003 |
| 3 | 0.9 | | 0.11 | | | 0.23 | 0.003 |
| 4 | 1.0 | | 0.12 | | | 0.31 | 0.004 |
| 5 | 1.1 | | 0.14 | | | 0.24 | 0.003 |
| 6 | 1.2 | | 0.18 | | | 0.34 | 0.006 |
| 7 | 1.3 | | 0.24 | | | 0.69 | 0.017 |
| 8 | 1.4 | | 0.30 | | | 0.56 | 0.017 |
| 9 | 1.5 | | 0.33 | | | 0.30 | 0.010 |
| 10 | 1.6 | | 0.24 | | | 0.03 | 0.001 |
| 11 | 1.7 | | 0.14 | | | 0.05 | 0.001 |
| 12 | 1.9 | | 0.12 | | | 0.03 | 0.001 |
| 13 | 2.1 | | 0.16 | | | 0.03 | 0.001 |
| 14 | 2.3 | | 0.14 | | | 0.04 | 0.001 |
| 15 | 2.5 | | 0.12 | | | 0.01 | 0.000 |
| Left Bank | 3.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.067** |

## Snow Course Survey Data and Calculations – Open Lake Plots

| **Location** | OL-08-02 | | | **Location** | OL-08-04 | | |
|---|---|---|---|---|---|---|---|
| Date: | 17-May-08 | | | Date: | 16-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** | **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] | [cm] | [kg] | [kg] | [g/cm$^3$] |
| 19 | 2.26 | 1.86 | 0.380 | 13 | 2.26 | 1.83 | 0.597 |
| 16 | 2.21 | 1.86 | 0.395 | 15 | 2.20 | 1.83 | 0.445 |
| 16 | 2.29 | 1.86 | 0.485 | 11 | 2.15 | 1.83 | 0.525 |
| Average: | | | 0.420 | Average: | | | 0.522 |
| | | | | | | | |
| **Depth** | **SWE** | | | **Depth** | **SWE** | | |
| [cm] | [mm] | | | [cm] | [mm] | | |
| 1 | 4.2 | | | 15 | 78.3 | | |
| 3 | 12.6 | | | 10 | 52.2 | | |
| 7 | 29.4 | | | 0 | 0.0 | | |
| 12 | 50.4 | | | 14 | 73.1 | | |
| 10 | 42.0 | | | 5 | 26.1 | | |
| 8 | 33.6 | | | 3 | 15.7 | | |
| 8 | 33.6 | | | 17 | 88.8 | | |
| 5 | 21.0 | | | 8 | 41.8 | | |
| 8 | 33.6 | | | 4 | 20.9 | | |
| 11 | 46.2 | | | 7 | 36.6 | | |
| 6 | 25.2 | | | 3 | 15.7 | | |
| 4 | 16.8 | | | 8 | 41.8 | | |
| 6 | 25.2 | | | 10 | 52.2 | | |
| 7 | 29.4 | | | 14 | 73.1 | | |
| 6 | 25.2 | | | 19 | 99.2 | | |
| 1 | 4.2 | | | 14 | 73.1 | | |
| 2 | 8.4 | | | 10 | 52.2 | | |
| 7 | 29.4 | | | 16 | 83.6 | | |
| 8 | 33.6 | | | 20 | 104.5 | | |
| 5 | 21.0 | | | 31 | 161.9 | | |
| 10 | 42.0 | | | 15 | 78.3 | | |
| 5 | 21.0 | | | 15 | 78.3 | | |
| 4 | 16.8 | | | 6 | 31.3 | | |
| 8 | 33.6 | | | 22 | 114.9 | | |
| 3 | 12.6 | | | 6 | 31.3 | | |
| 0 | 0.0 | | | 6 | 31.3 | | |
| 3 | 12.6 | | | 14 | 73.1 | | |
| 3 | 12.6 | | | 0 | 0.0 | | |
| 4 | 16.8 | | | 9 | 47.0 | | |
| 8 | 33.6 | | | 7 | 36.6 | | |
| **5.8** | **24.2** | **Average** | | **10.9** | **57.1** | | |

## Snow Course Survey Data and Calculations – Exposed Lowland Plots

| **Location** | EL-08-01 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 40 | 2.68 | 1.91 | 0.347 |
| 43 | 2.55 | 1.91 | 0.269 |
| 30 | 2.4 | 1.91 | 0.295 |
| Average: | | | 0.304 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 56 | 170.0 |
| 54 | 163.9 |
| 45 | 136.6 |
| 39 | 118.4 |
| 48 | 145.7 |
| 24 | 72.9 |
| 31 | 94.1 |
| 33 | 100.2 |
| 30 | 91.1 |
| 38 | 115.4 |
| 45 | 136.6 |
| 39 | 118.4 |
| 42 | 127.5 |
| 51 | 154.8 |
| 50 | 151.8 |
| 62 | 188.2 |
| 62 | 188.2 |
| 68 | 206.4 |
| 38 | 115.4 |
| 42 | 127.5 |
| 44 | 133.6 |
| 82 | 248.9 |
| 64 | 194.3 |
| 62 | 188.2 |
| 56 | 170.0 |
| 69 | 209.5 |
| 50 | 151.8 |
| 59 | 179.1 |
| 46 | 139.6 |
| 45 | 136.6 |
| **49.1** | **149.1** |

| **Location** | EL-08-02 | | |
|---|---|---|---|
| Date: | 16-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 23 | 2.16 | 1.88 | 0.220 |
| 26 | 2.19 | 1.88 | 0.215 |
| 28 | 2.21 | 1.88 | 0.213 |
| Average: | | | 0.216 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 9 | 19.4 |
| 10 | 21.6 |
| 8 | 17.3 |
| 15 | 32.4 |
| 4 | 8.6 |
| 6 | 12.9 |
| 0 | 0.0 |
| 10 | 21.6 |
| 15 | 32.4 |
| 12 | 25.9 |
| 9 | 19.4 |
| 21 | 45.3 |
| 17 | 36.7 |
| 19 | 41.0 |
| 25 | 54.0 |
| 18 | 38.8 |
| 16 | 34.5 |
| 21 | 45.3 |
| 8 | 17.3 |
| 0 | 0.0 |
| 8 | 17.3 |
| 14 | 30.2 |
| 20 | 43.2 |
| 14 | 30.2 |
| 7 | 15.1 |
| 12 | 25.9 |
| 6 | 12.9 |
| 6 | 12.9 |
| 0 | 0.0 |
| 9 | 19.4 |
| **11.3** | **24.4** |

## Snow Course Survey Data and Calculations – Sheltered Lowland Plots

| **Location** | SL-08-02 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 36 | 2.46 | 1.82 | 0.321 |
| 32 | 2.27 | 1.82 | 0.254 |
| 30 | 2.3 | 1.82 | 0.289 |
| Average: | | | 0.288 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 34 | 97.8 |
| 9 | 25.9 |
| 19 | 54.7 |
| 15 | 43.2 |
| 16 | 46.0 |
| 21 | 60.4 |
| 24 | 69.1 |
| 26 | 74.8 |
| 36 | 103.6 |
| 35 | 100.7 |
| 57 | 164.0 |
| 116 | 333.8 |
| 77 | 221.6 |
| 69 | 198.6 |
| 45 | 129.5 |
| 40 | 115.1 |
| 25 | 71.9 |
| 24 | 69.1 |
| 22 | 63.3 |
| 47 | 135.2 |
| 33 | 95.0 |
| 42 | 120.9 |
| 43 | 123.7 |
| 50 | 143.9 |
| 38 | 109.3 |
| 42 | 120.9 |
| 42 | 120.9 |
| 32 | 92.1 |
| 44 | 126.6 |
| 23 | 66.2 |
| **38.2** | **109.9** |

| **Location** | SL-08-03 | | |
|---|---|---|---|
| Date: | 16-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 22 | 2.13 | 1.82 | 0.254 |
| 63 | 2.78 | 1.82 | 0.275 |
| 63 | 3.05 | 1.82 | 0.352 |
| Average: | | | 0.294 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 17 | 50.0 |
| 17 | 50.0 |
| 18 | 52.9 |
| 31 | 91.1 |
| 36 | 105.8 |
| 14 | 41.1 |
| 5 | 14.7 |
| 17 | 50.0 |
| 24 | 70.5 |
| 22 | 64.6 |
| 23 | 67.6 |
| 36 | 105.8 |
| 32 | 94.0 |
| 45 | 132.2 |
| 76 | 223.3 |
| 50 | 146.9 |
| 39 | 114.6 |
| 48 | 141.0 |
| 61 | 179.2 |
| 50 | 146.9 |
| 52 | 152.8 |
| 68 | 199.8 |
| 118 | 346.7 |
| 89 | 261.5 |
| 76 | 223.3 |
| 7 | 20.6 |
| 18 | 52.9 |
| 14 | 41.1 |
| 24 | 70.5 |
| 11 | 32.3 |
| **37.9** | **111.5** |

# Snow Course Survey Data and Calculations – North Aspect Plots

| **Location** | NA-08-01 | | |
|---|---|---|---|
| Date: | 19-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 33 | 2.64 | 1.8 | 0.459 |
| 25 | 2.25 | 1.8 | 0.325 |
| 12 | 2.08 | 1.8 | 0.421 |
| Average: | | | 0.402 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 14 | 56.2 |
| 9 | 36.2 |
| 17 | 68.3 |
| 23 | 92.4 |
| 0 | 0.0 |
| 18 | 72.3 |
| 90 | 361.6 |
| 110 | 441.9 |
| 11 | 44.2 |
| 43 | 172.7 |
| 75 | 301.3 |
| 46 | 184.8 |
| 49 | 196.8 |
| 4 | 16.1 |
| 30 | 120.5 |
| 51 | 204.9 |
| 13 | 52.2 |
| 15 | 60.3 |
| 12 | 48.2 |
| 36 | 144.6 |
| 35 | 140.6 |
| 34 | 136.6 |
| 21 | 84.4 |
| 22 | 88.4 |
| 24 | 96.4 |
| 35 | 140.6 |
| 19 | 76.3 |
| 24 | 96.4 |
| 29 | 116.5 |
| 9 | 36.2 |
| **30.6** | **122.9** |

| **Location** | NA-08-03 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 36 | 2.52 | 1.89 | 0.316 |
| 33 | 2.54 | 1.89 | 0.355 |
| 23 | 2.18 | 1.89 | 0.228 |
| Average: | | | 0.300 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 16 | 47.9 |
| 18 | 53.9 |
| 21 | 62.9 |
| 23 | 68.9 |
| 15 | 44.9 |
| 18 | 53.9 |
| 23 | 68.9 |
| 19 | 56.9 |
| 31 | 92.9 |
| 22 | 65.9 |
| 10 | 30.0 |
| 0 | 0.0 |
| 0 | 0.0 |
| 4 | 12.0 |
| 41 | 122.8 |
| 28 | 83.9 |
| 21 | 62.9 |
| 27 | 80.9 |
| 23 | 68.9 |
| 42 | 125.8 |
| 22 | 65.9 |
| 40 | 119.8 |
| 47 | 140.8 |
| 41 | 122.8 |
| 43 | 128.8 |
| 26 | 77.9 |
| 23 | 68.9 |
| 35 | 104.9 |
| 34 | 101.9 |
| 57 | 170.8 |
| **25.7** | **76.9** |

# Snow Course Survey Data and Calculations – East Aspect Plots

| **Location** | EA-08-02 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 32 | 2.47 | 1.82 | 0.367 |
| 28 | 2.37 | 1.82 | 0.354 |
| 31 | 2.4 | 1.82 | 0.338 |
| Average: | | | 0.353 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 35 | 123.5 |
| 38 | 134.1 |
| 45 | 158.8 |
| 48 | 169.4 |
| 50 | 176.4 |
| 59 | 208.2 |
| 60 | 211.7 |
| 71 | 250.5 |
| 63 | 222.3 |
| 52 | 183.5 |
| 60 | 211.7 |
| 48 | 169.4 |
| 45 | 158.8 |
| 48 | 169.4 |
| 54 | 190.5 |
| 59 | 208.2 |
| 59 | 208.2 |
| 55 | 194.1 |
| 54 | 190.5 |
| 54 | 190.5 |
| 34 | 120.0 |
| 20 | 70.6 |
| 25 | 88.2 |
| 38 | 134.1 |
| 39 | 137.6 |
| 49 | 172.9 |
| 37 | 130.6 |
| 35 | 123.5 |
| 33 | 116.4 |
| 39 | 137.6 |
| **46.9** | **160.0** |

| **Location** | EA-08-03 | | |
|---|---|---|---|
| Date: | 16-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 19 | 2.22 | 1.87 | 0.332 |
| 14 | 2.08 | 1.87 | 0.271 |
| 24 | 2.39 | 1.87 | 0.391 |
| Average: | | | 0.331 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 18 | 59.6 |
| 19 | 63.0 |
| 26 | 86.2 |
| 23 | 76.2 |
| 14 | 46.4 |
| 8 | 26.5 |
| 18 | 59.6 |
| 14 | 46.4 |
| 0 | 0.0 |
| 6 | 19.9 |
| 0 | 0.0 |
| 15 | 49.7 |
| 27 | 89.5 |
| 11 | 36.4 |
| 23 | 76.2 |
| 14 | 46.4 |
| 29 | 96.1 |
| 16 | 53.0 |
| 13 | 43.1 |
| 22 | 72.9 |
| 0 | 0.0 |
| 9 | 29.8 |
| 14 | 46.4 |
| 0 | 0.0 |
| 15 | 49.7 |
| 16 | 53.0 |
| 19 | 63.0 |
| 8 | 26.5 |
| 18 | 59.6 |
| 7 | 23.2 |
| 22 | 72.9 |
| **14.3** | **47.5** |

# Snow Course Survey Data and Calculations – South Aspect Plots

| **Location** | SA-08-02 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 60 | 3.07 | 1.87 | 0.361 |
| 135 | 4.85 | 1.87 | 0.398 |
| 38 | 2.21 | 1.87 | 0.161 |
| Average: | | | 0.307 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 61 | 187.2 |
| 104 | 319.2 |
| 81 | 248.6 |
| 107 | 328.4 |
| 118 | 362.1 |
| 91 | 279.3 |
| 45 | 138.1 |
| 54 | 165.7 |
| 78 | 239.4 |
| 82 | 251.6 |
| 55 | 168.8 |
| 63 | 193.3 |
| 55 | 168.8 |
| 51 | 156.5 |
| 58 | 178.0 |
| 91 | 279.3 |
| 50 | 153.4 |
| 48 | 147.3 |
| 48 | 147.3 |
| 17 | 52.2 |
| 0 | 0.0 |
| 10 | 30.7 |
| 8 | 24.6 |
| 0 | 0.0 |
| 50 | 153.4 |
| 0 | 0.0 |
| 3 | 9.2 |
| 2 | 6.1 |
| 75 | 230.2 |
| 90 | 276.2 |
| **53.2** | **163.2** |

| **Location** | SA-08-03 | | |
|---|---|---|---|
| Date: | 16-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 30 | 2.38 | 1.84 | 0.325 |
| 31 | 2.37 | 1.84 | 0.309 |
| 24 | 2.32 | 1.84 | 0.361 |
| Average: | | | 0.331 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 27 | 89.5 |
| 48 | 159.1 |
| 21 | 69.6 |
| 0 | 0.0 |
| 21 | 69.6 |
| 17 | 56.3 |
| 14 | 46.4 |
| 0 | 0.0 |
| 15 | 49.7 |
| 19 | 63.0 |
| 37 | 122.6 |
| 39 | 129.2 |
| 27 | 89.5 |
| 38 | 125.9 |
| 42 | 139.2 |
| 21 | 69.6 |
| 24 | 79.5 |
| 4 | 13.3 |
| 20 | 66.3 |
| 27 | 89.5 |
| 43 | 142.5 |
| 35 | 116.0 |
| 13 | 43.1 |
| 21 | 69.6 |
| 17 | 56.3 |
| 0 | 0.0 |
| 0 | 0.0 |
| 0 | 0.0 |
| 16 | 53.0 |
| 23 | 76.2 |
| **21.0** | **69.5** |

## Snow Course Survey Data and Calculations – West Aspect Plots

| **Location** | WA-08-01 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 17 | 2.30 | 1.88 | 0.446 |
| 16 | 2.35 | 1.88 | 0.530 |
| 15 | 2.11 | 1.88 | 0.277 |
| Average: | | | 0.418 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 4 | 16.7 |
| 28 | 116.9 |
| 30 | 125.3 |
| 30 | 125.3 |
| 43 | 179.5 |
| 34 | 142.0 |
| 29 | 121.1 |
| 28 | 116.9 |
| 32 | 133.6 |
| 28 | 116.9 |
| 41 | 171.2 |
| 28 | 116.9 |
| 32 | 133.6 |
| 26 | 108.6 |
| 36 | 150.3 |
| 34 | 142.0 |
| 34 | 142.0 |
| 35 | 146.1 |
| 30 | 125.3 |
| 25 | 104.4 |
| 22 | 91.9 |
| 34 | 142.0 |
| 35 | 146.1 |
| 31 | 129.4 |
| 36 | 150.3 |
| 27 | 112.7 |
| 16 | 66.8 |
| 28 | 116.9 |
| **29.9** | **124.7** |

| **Location** | WA-08-02 | | |
|---|---|---|---|
| Date: | 17-May-08 | | |
| **Depth** | **Wgt** | **Tare** | **Density** |
| [cm] | [kg] | [kg] | [g/cm$^3$] |
| 8 | 2.07 | 1.86 | 0.474 |
| 16 | 2.19 | 1.86 | 0.372 |
| 10 | 2.09 | 1.86 | 0.415 |
| Average: | | | 0.420 |

| **Depth** | **SWE** |
|---|---|
| [cm] | [mm] |
| 17 | 71.4 |
| 12 | 50.4 |
| 9 | 37.8 |
| 23 | 96.7 |
| 13 | 54.6 |
| 18 | 75.7 |
| 9 | 37.8 |
| 9 | 37.8 |
| 3 | 12.6 |
| 9 | 37.8 |
| 6 | 25.2 |
| 6 | 25.2 |
| 21 | 88.3 |
| 11 | 46.2 |
| 10 | 42.0 |
| 12 | 50.4 |
| 16 | 67.2 |
| 20 | 84.1 |
| 23 | 96.7 |
| 20 | 84.1 |
| 7 | 29.4 |
| 17 | 71.4 |
| 27 | 113.5 |
| 0 | 0.0 |
| 7 | 29.4 |
| 26 | 109.3 |
| 28 | 117.7 |
| 23 | 96.7 |
| 19 | 79.9 |
| 23 | 96.7 |
| **14.8** | **62.2** |

# APPENDIX A3

# HYDROLOGY DATA FOR MADRID PROJECT AREA

# A3 HYDROLOGY DATA FOR MADRID PROJECT AREA

This appendix contains hydrology data referenced in the body of the report. A table of contents for the appendix follows:


| Station | Description | Page |
|---|---|---|
| | **HYDROMETRY** | |
| H93 – Glenn Lake and Outflow | Factsheet | A3-3 |
| | Stage-Discharge Rating Curve (2008) | A3-4 |
| | Stage-Discharge Data (2008) | A3-4 |
| | Mean Daily Discharge and Water Level Data (2008) | A3-5 |
| | Discharge Data Sheets (2008) | A3-6 |
| H82 – Ogama Lake and Outflow | Factsheet | A3-10 |
| | Stage-Discharge Rating Curve (2008) | A3-11 |
| | Stage-Discharge Data (2008) | A3-11 |
| | Mean Daily Discharge and Water Level Data (2008) | A3-12 |
| | Discharge Data Sheets (2008) | A3-13 |
| H81 – Patch Lake and Outflow | Factsheet | A3-17 |
| | Stage-Discharge Rating Curve (2008) | A318 |
| | Stage-Discharge Data (2008) | A3-18 |
| | Mean Daily Discharge and Water Level Data (2008) | A3-19 |
| | Discharge Data Sheets (2008) | A3-20 |
| H89 – P.O. Outflow | Factsheet | A3-24 |
| | Stage-Discharge Rating Curve (2008) | A3-25 |
| | Stage-Discharge Data (2008) | A3-25 |
| | Mean Daily Discharge and Water Level Data (2008) | A3-26 |
| | Discharge Data Sheets (2008) | A3-27 |
| H90 – P.O. Lake | Factsheet | A3-31 |
| | Stage-Discharge Data (2008) | A3-32 |
| | Mean Daily Water Level Data (2008) | A3-32 |
| | Discharge Data Sheets (2008) | A3-33 |
| H92 – Windy Lake and Outflow | Factsheet | A3-37 |
| | Stage-Discharge Rating Curve (2008) | A3-38 |
| | Stage-Discharge Data (2008) | A3-38 |
| | Mean Daily Discharge and Water Level Data (2008) | A3-39 |
| | Discharge Data Sheets (2008) | A3-40 |
| H91 – Wolverine Lake | Factsheet | A3-44 |
| and Outflow | Stage Data (2008) | A3-45 |
| | Mean Daily Water Level Data (2008) | A3-45 |
| | | |
| | | |
| | | |
| | | |

# WINDY LAKE AND OUTFLOW HYDROMETRIC STATION

**H92**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located approximately 100 m upstream, on the left downstream bank of the Windy Lake outflow (north shore).

| Operational: | 2006<br>29/5-8/9 | 2007<br>24/5-15/9 | 2008<br>22/6-9/9 | 2009 |
|---|---|---|---|---|

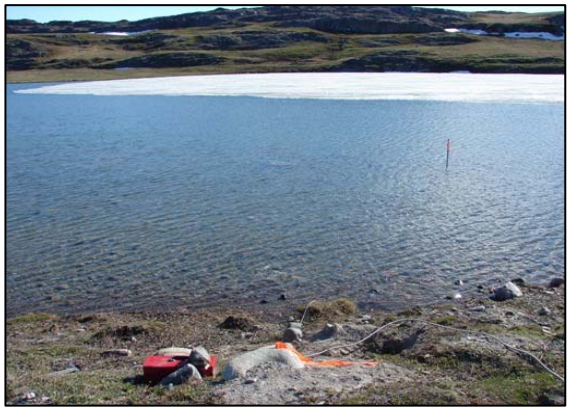
Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 13.9 km$^2$

Coordinates: UTM: 431507 m E, 7555043 m N (Zone 13W NAD83) Lat/Long: 68°06'04" N, 106°38'45" W

Instruments: Optimum Instruments Datalogger, Keller Transducer

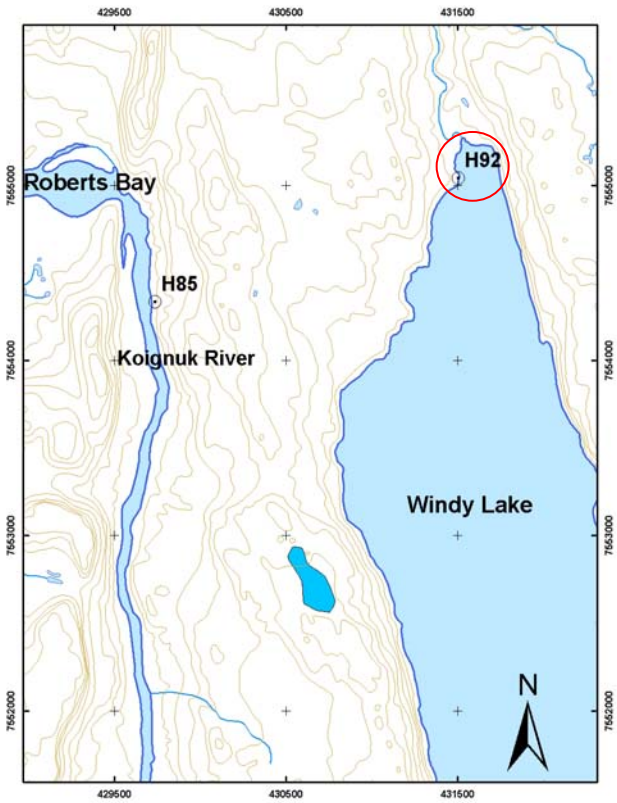
Aerial view of Station H92.

Station H92 upstream view of the outlet channel.

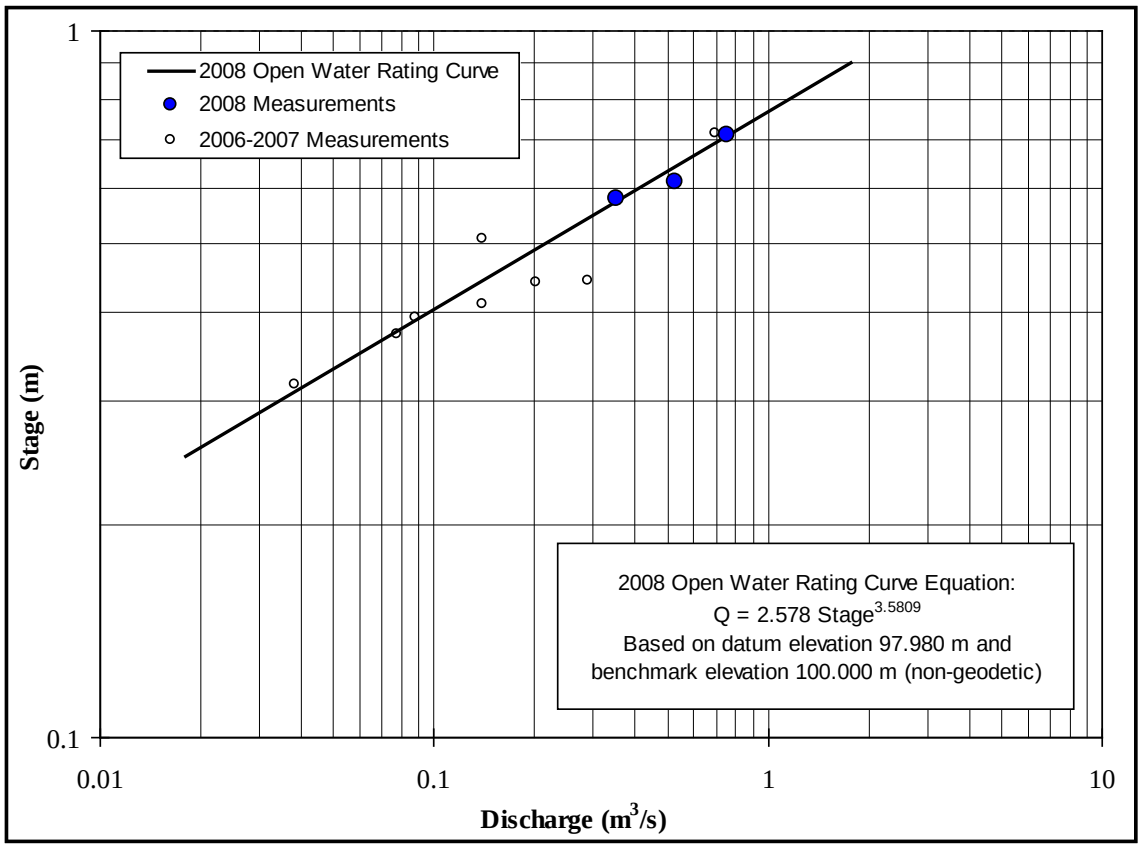


Station H92 benchmark and datalogger location looking east.

Station H92 downstream view of the outlet channel.




NTS Mapping of Area.




**Glenn Outflow Station H93 – Stage-Discharge Rating Curve (2008)**

## Glenn Outflow Station H93 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 19-Jun-2008 10:05 | | 1.609 | | 97.216 | | 1.358 |
| 02-Jul-2008 11:03 | 98.694 | 1.469 | 97.225 | | 0.714 | 0.749 |
| 12-Aug-2008 16:13 | 98.561 | 1.344 | 97.217 | | 0.581 | 0.352 |
| 09-Sep-2008 10:50 | 98.591 | 1.384 | 97.207 | | 0.611 | 0.523 |

## H93 Glenn Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 0.755 | 0.410 | 0.496 | 0.110 E | - | - |
| 2 | - | - | - | - | - | - | 0.733 | 0.392 | 0.560 | 0.093 E | - | - |
| 3 | - | - | - | - | - | 0.007 E | 0.702 | 0.375 | 0.581 | 0.076 E | - | - |
| 4 | - | - | - | - | - | 0.013 E | 0.670 | 0.371 | 0.569 | 0.059 E | - | - |
| 5 | - | - | - | - | - | 0.019 E | 0.640 | 0.372 | 0.549 | 0.042 E | - | - |
| 6 | - | - | - | - | - | 0.025 E | 0.617 | 0.363 | 0.527 | 0.025 E | - | - |
| 7 | - | - | - | - | - | 0.033 E | 0.592 | 0.353 | 0.499 | 0.013 E | - | - |
| 8 | - | - | - | - | - | 0.055 E | 0.570 | 0.346 | 0.479 | 0.006 E | - | - |
| 9 | - | - | - | - | - | 0.086 E | 0.555 | 0.338 | 0.469 P | - | - | - |
| 10 | - | - | - | - | - | 0.141 E | 0.538 | 0.332 | 0.453 E | - | - | - |
| 11 | - | - | - | - | - | 0.239 E | 0.526 | 0.335 | 0.439 E | - | - | - |
| 12 | - | - | - | - | - | 0.351 E | 0.522 | 0.353 | 0.424 E | - | - | - |
| 13 | - | - | - | - | - | 0.449 E | 0.520 | 0.357 | 0.408 E | - | - | - |
| 14 | - | - | - | - | - | 0.519 E | 0.502 | 0.356 | 0.392 E | - | - | - |
| 15 | - | - | - | - | - | 0.598 E | 0.486 | 0.353 | 0.376 E | - | - | - |
| 16 | - | - | - | - | - | 0.670 E | 0.470 | 0.347 | 0.355 E | - | - | - |
| 17 | - | - | - | - | - | 0.714 E | 0.459 | 0.333 | 0.334 E | - | - | - |
| 18 | - | - | - | - | - | 0.746 E | 0.458 | 0.330 | 0.313 E | - | - | - |
| 19 | - | - | - | - | - | 0.763 E | 0.464 | 0.318 | 0.292 E | - | - | - |
| 20 | - | - | - | - | - | 0.778 E | 0.465 | 0.306 | 0.271 E | - | - | - |
| 21 | - | - | - | - | - | 0.788 E | 0.456 | 0.297 | 0.251 E | - | - | - |
| 22 | - | - | - | - | - | 0.790 E | 0.441 | 0.292 | 0.237 E | - | - | - |
| 23 | - | - | - | - | - | 0.798 P | 0.431 | 0.297 | 0.224 E | - | - | - |
| 24 | - | - | - | - | - | 0.786 | 0.419 | 0.296 | 0.214 E | - | - | - |
| 25 | - | - | - | - | - | 0.790 | 0.413 | 0.290 | 0.201 E | - | - | - |
| 26 | - | - | - | - | - | 0.790 | 0.441 | 0.283 | 0.187 E | - | - | - |
| 27 | - | - | - | - | - | 0.788 | 0.441 | 0.302 | 0.177 E | - | - | - |
| 28 | - | - | - | - | - | 0.777 | 0.437 | 0.309 | 0.161 E | - | - | - |
| 29 | - | - | - | - | - | 0.764 | 0.431 | 0.328 | 0.144 E | - | - | - |
| 30 | - | - | - | - | - | 0.767 | 0.425 | 0.369 | 0.127 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.412 | 0.426 | - | - | - | - |
| MIN | - | - | - | - | - | 0.007 | 0.412 | 0.283 | 0.127 | 0.006 | - | - |
| MEAN | - | - | - | - | - | 0.502 | 0.516 | 0.340 | 0.357 | 0.053 | - | - |
| MAX | - | - | - | - | - | 0.798 | 0.755 | 0.426 | 0.581 | 0.110 | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 98.690 | 98.578 | 98.611 | - | - | - |
| 2 | - | - | - | - | - | - | 98.684 | 98.571 | 98.633 | - | - | - |
| 3 | - | - | - | - | - | - | 98.675 | 98.564 | 98.640 | - | - | - |
| 4 | - | - | - | - | - | - | 98.666 | 98.562 | 98.636 | - | - | - |
| 5 | - | - | - | - | - | - | 98.658 | 98.562 | 98.629 | - | - | - |
| 6 | - | - | - | - | - | - | 98.651 | 98.558 | 98.622 | - | - | - |
| 7 | - | - | - | - | - | - | 98.643 | 98.554 | 98.612 | - | - | - |
| 8 | - | - | - | - | - | - | 98.636 | 98.551 | 98.605 | - | - | - |
| 9 | - | - | - | - | - | - | 98.631 | 98.547 | 98.601 P | - | - | - |
| 10 | - | - | - | - | - | - | 98.626 | 98.544 | - | - | - | - |
| 11 | - | - | - | - | - | - | 98.622 | 98.546 | - | - | - | - |
| 12 | - | - | - | - | - | - | 98.620 | 98.554 | - | - | - | - |
| 13 | - | - | - | - | - | - | 98.619 | 98.556 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.613 | 98.555 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.608 | 98.554 | - | - | - | - |
| 16 | - | - | - | - | - | - | 98.602 | 98.551 | - | - | - | - |
| 17 | - | - | - | - | - | - | 98.598 | 98.545 | - | - | - | - |
| 18 | - | - | - | - | - | - | 98.597 | 98.543 | - | - | - | - |
| 19 | - | - | - | - | - | - | 98.599 | 98.538 | - | - | - | - |
| 20 | - | - | - | - | - | - | 98.600 | 98.532 | - | - | - | - |
| 21 | - | - | - | - | - | - | 98.596 | 98.527 | - | - | - | - |
| 22 | - | - | - | - | - | - | 98.591 | 98.524 | - | - | - | - |
| 23 | - | - | - | - | - | 98.701 P | 98.587 | 98.527 | - | - | - | - |
| 24 | - | - | - | - | - | 98.698 | 98.582 | 98.526 | - | - | - | - |
| 25 | - | - | - | - | - | 98.699 | 98.580 | 98.523 | - | - | - | - |
| 26 | - | - | - | - | - | 98.699 | 98.591 | 98.519 | - | - | - | - |
| 27 | - | - | - | - | - | 98.698 | 98.591 | 98.529 | - | - | - | - |
| 28 | - | - | - | - | - | 98.695 | 98.589 | 98.533 | - | - | - | - |
| 29 | - | - | - | - | - | 98.692 | 98.587 | 98.542 | - | - | - | - |
| 30 | - | - | - | - | - | 98.693 | 98.585 | 98.561 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.579 | 98.585 | - | - | - | - |
| MIN | - | - | - | - | - | 98.692 | 98.579 | 98.519 | 98.601 | - | - | - |
| MEAN | - | - | - | - | - | 98.697 | 98.616 | 98.547 | 98.621 | - | - | - |
| MAX | - | - | - | - | - | 98.701 | 98.690 | 98.585 | 98.640 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Glenn Outflow

LOCATION: Outlet of Glenn Lake

COORDINATES: 430512 m E, 7562013 m N (NAD83)

MEASUREMENT DATE: 19 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 10:25 h

MEASUREMENT END TIME: 10:45 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.5 | | 0.15 | | | 0.02 | 0.001 |
| 3 | 1.0 | | 0.18 | | | 0.01 | 0.001 |
| 4 | 1.5 | | 0.34 | | | 0.13 | 0.022 |
| 5 | 2.0 | | 0.36 | | | 0.56 | 0.101 |
| 6 | 2.5 | | 0.40 | | | 0.55 | 0.110 |
| 7 | 3.0 | | 0.61 | | | 0.59 | 0.180 |
| 8 | 3.5 | | 0.62 | | | 0.74 | 0.229 |
| 9 | 4.0 | | 0.66 | | | 0.58 | 0.191 |
| 10 | 4.5 | | 0.71 | | | 0.81 | 0.288 |
| 11 | 5.0 | | 0.73 | | | 0.38 | 0.139 |
| 12 | 5.5 | | 0.25 | | | 0.37 | 0.046 |
| 13 | 6.0 | | 0.18 | | | 0.35 | 0.032 |
| 14 | 6.5 | | 0.16 | | | 0.22 | 0.018 |
| Left Bank | 7.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.358** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Glenn Outflow

LOCATION: Outlet of Glenn Lake

COORDINATES: 430512 m E, 7562013 m N (NAD83)

MEASUREMENT DATE: 2 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:24 h

MEASUREMENT END TIME: 11:36 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Right Bank | 6.4 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 6.0 | | 0.13 | | | 0.07 | 0.003 |
| 3 | 5.7 | | 0.24 | | | 0.05 | 0.004 |
| 4 | 5.4 | | 0.22 | | | 0.08 | 0.006 |
| 5 | 5.0 | | 0.21 | | | 0.27 | 0.026 |
| 6 | 4.5 | | 0.27 | | | 0.31 | 0.033 |
| 7 | 4.2 | | 0.52 | | | 0.37 | 0.067 |
| 8 | 3.8 | | 0.54 | | | 0.81 | 0.175 |
| 9 | 3.4 | | 0.48 | | | 0.83 | 0.159 |
| 10 | 3.0 | | 0.47 | | | 0.80 | 0.132 |
| 11 | 2.7 | | 0.48 | | | 0.69 | 0.099 |
| 12 | 2.4 | | 0.42 | | | 0.28 | 0.041 |
| 13 | 2.0 | | 0.22 | | | 0.03 | 0.003 |
| Left Bank | 1.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.749** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Glenn Outflow

LOCATION: Outlet of Glenn Lake

COORDINATES: 430512 m E, 7562013 m N (NAD83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 15:45 h

MEASUREMENT END TIME: 16:13 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.18 | | | 0.02 | 0.004 |
| 3 | 2.0 | | 0.16 | | | 0.02 | 0.003 |
| 4 | 3.0 | | 0.16 | | | 0.07 | 0.011 |
| 5 | 4.0 | | 0.20 | | | 0.08 | 0.012 |
| 6 | 4.5 | | 0.26 | | | 0.32 | 0.042 |
| 7 | 5.0 | | 0.22 | | | 0.43 | 0.047 |
| 8 | 5.5 | | 0.21 | | | 0.44 | 0.046 |
| 9 | 6.0 | | 0.21 | | | 0.53 | 0.056 |
| 10 | 6.5 | | 0.19 | | | 0.52 | 0.049 |
| 11 | 7.0 | | 0.18 | | | 0.43 | 0.039 |
| 12 | 7.5 | | 0.18 | | | 0.33 | 0.030 |
| 13 | 8.0 | | 0.18 | | | 0.15 | 0.011 |
| 14 | 8.3 | | 0.20 | | | 0.05 | 0.003 |
| Left Bank | 8.5 | | 0.18 | | | 0.00 | 0.000 |
| | | | | | | | **0.352** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Glenn Outflow

LOCATION: Outlet of Glenn Lake

COORDINATES: 430512 m E, 7562013 m N (NAD83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 10:50 h

MEASUREMENT END TIME: 11:12 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.1 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.3 | | 0.05 | | | 0.00 | 0.000 |
| 3 | 0.6 | | 0.10 | | | 0.19 | 0.006 |
| 4 | 0.9 | | 0.31 | | | 0.52 | 0.048 |
| 5 | 1.2 | | 0.37 | | | 0.62 | 0.069 |
| 6 | 1.5 | | 0.39 | | | 0.66 | 0.077 |
| 7 | 1.8 | | 0.42 | | | 0.84 | 0.106 |
| 8 | 2.1 | | 0.44 | | | 0.80 | 0.106 |
| 9 | 2.4 | | 0.43 | | | 0.69 | 0.074 |
| 10 | 2.6 | | 0.24 | | | 0.52 | 0.037 |
| Right Bank | 3.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.523** |

# OGAMA LAKE AND OUTFLOW HYDROMETRIC STATION

# H82

FACTSHEET

## *LOCATION AND PURPOSE*

Located on the left bank of Ogama Lake, approximately 60 m upstream of the outflow.

| Operational: | 2006<br>31/5-8/9 | 2007<br>23/5-14/9 | 2008<br>23/6-9/9 | 2009 |
|---|---|---|---|---|

Benchmark: Top of embedded boulder, 100.000 m (local) Drainage Area: 72.1 km$^2$

Coordinates: UTM: 435648 m E, 7555130 m N (Zone 13W NAD83) Lat/Long: 68°06'10" N, 106°32'47" W

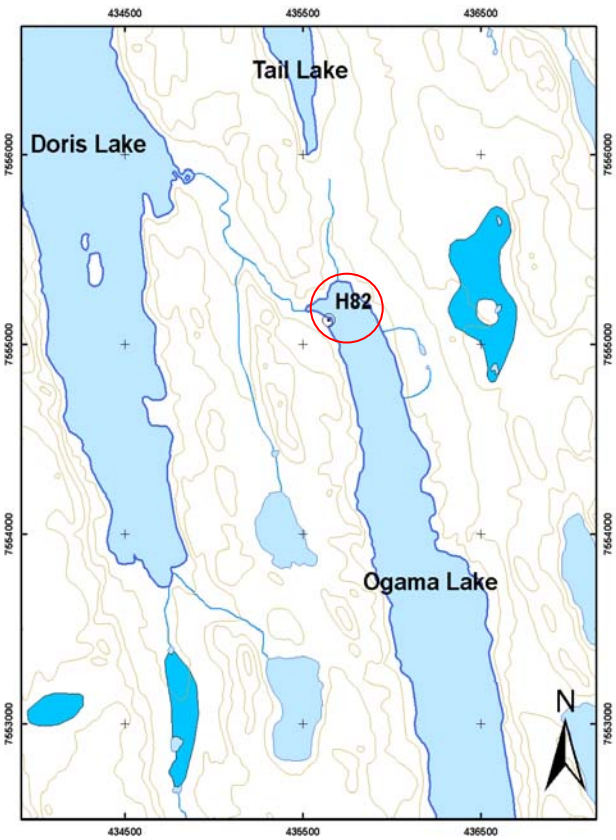
Instruments: Optimum Instruments Datalogger, Keller Transducer

Station H82 looking east before snow melt.

Aerial view of north area of Ogama Lake, looking east.

Station H82 looking east.

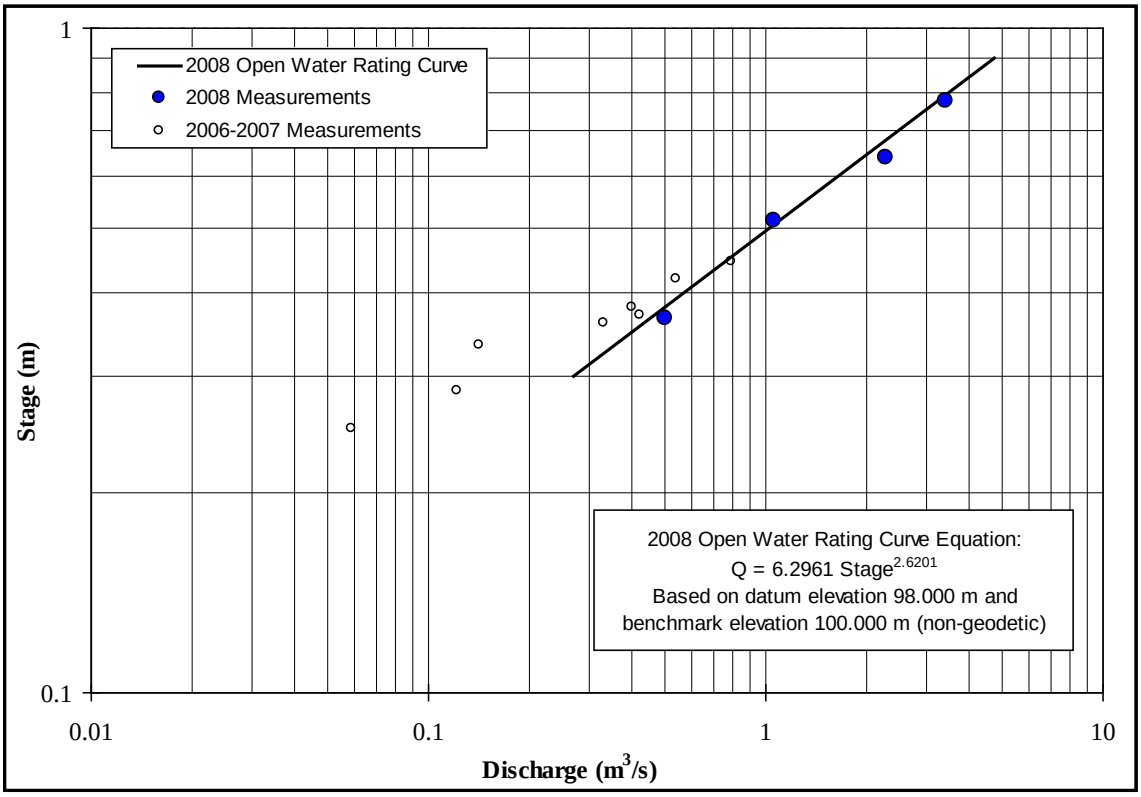
Station H82 looking south.




NTS Mapping of Area.

FACT-H82-2008.DOC

**Golder Associates**




**Ogama Outflow Station H82 – Stage-Discharge Rating Curve (2008)**

## Ogama Outflow Station H82 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 23-Jun-2008 11:30 | 98.778 | | | 97.308 | 0.778 | 3.408 |
| 02-Jul-2008 14:57 | 98.638 | 1.320 | 97.318 | | 0.638 | 2.258 |
| 12-Aug-2008 14:37 | 98.367 | 1.072 | 97.295 | | 0.367 | 0.505 |
| 09-Sep-2008 15:10 | 98.514 | 1.203 | 97.311 | | 0.514 | 1.055 |

## H82 Ogama Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 2.000 E | 0.672 | 0.791 | 0.178 E | - | - |
| 2 | - | - | - | - | - | - | 1.838 P | 0.625 | 0.945 | 0.152 E | - | - |
| 3 | - | - | - | - | - | 0.008 E | 1.739 | 0.581 | 1.062 | 0.126 E | - | - |
| 4 | - | - | - | - | - | 0.016 E | 1.609 | 0.567 | 1.124 | 0.100 E | - | - |
| 5 | - | - | - | - | - | 0.024 E | 1.500 | 0.551 | 1.142 | 0.074 E | - | - |
| 6 | - | - | - | - | - | 0.042 E | 1.401 | 0.530 | 1.149 | 0.054 E | - | - |
| 7 | - | - | - | - | - | 0.062 E | 1.302 | 0.506 | 1.138 | 0.034 E | - | - |
| 8 | - | - | - | - | - | 0.072 E | 1.208 | 0.488 | 1.113 | 0.023 E | - | - |
| 9 | - | - | - | - | - | 0.130 E | 1.129 | 0.470 | 1.102 P | 0.016 E | - | - |
| 10 | - | - | - | - | - | 0.218 E | 1.070 | 0.463 | 1.070 E | 0.010 E | - | - |
| 11 | - | - | - | - | - | 0.400 E | 1.016 | 0.456 | 1.026 E | - | - | - |
| 12 | - | - | - | - | - | 0.578 E | 0.962 | 0.489 | 0.981 E | - | - | - |
| 13 | - | - | - | - | - | 0.859 E | 0.927 | 0.494 | 0.934 E | - | - | - |
| 14 | - | - | - | - | - | 1.164 E | 0.877 | 0.494 | 0.881 E | - | - | - |
| 15 | - | - | - | - | - | 1.463 E | 0.832 | 0.477 | 0.828 E | - | - | - |
| 16 | - | - | - | - | - | 1.848 E | 0.793 | 0.469 | 0.775 E | - | - | - |
| 17 | - | - | - | - | - | 2.233 E | 0.767 | 0.452 | 0.722 E | - | - | - |
| 18 | - | - | - | - | - | 2.618 E | 0.743 | 0.443 | 0.669 E | - | - | - |
| 19 | - | - | - | - | - | 2.900 E | 0.741 | 0.420 | 0.616 E | - | - | - |
| 20 | - | - | - | - | - | 3.100 E | 0.717 | 0.408 | 0.584 E | - | - | - |
| 21 | - | - | - | - | - | 3.180 E | 0.690 | 0.394 | 0.535 E | - | - | - |
| 22 | - | - | - | - | - | 0.000 E | 0.659 | 0.388 | 0.490 E | - | - | - |
| 23 | - | - | - | - | - | 3.140 E | 0.629 | 0.394 | 0.449 E | - | - | - |
| 24 | - | - | - | - | - | 3.000 E | 0.615 | 0.392 | 0.404 E | - | - | - |
| 25 | - | - | - | - | - | 2.900 E | 0.591 | 0.393 | 0.367 E | - | - | - |
| 26 | - | - | - | - | - | 2.780 E | 0.662 | 0.385 | 0.326 E | - | - | - |
| 27 | - | - | - | - | - | 2.640 E | 0.665 | 0.403 | 0.290 E | - | - | - |
| 28 | - | - | - | - | - | 2.500 E | 0.665 | 0.407 | 0.258 E | - | - | - |
| 29 | - | - | - | - | - | 2.330 E | 0.669 | 0.450 | 0.226 E | - | - | - |
| 30 | - | - | - | - | - | 2.150 E | 0.673 | 0.542 | 0.200 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.654 | 0.655 | - | - | - | - |
| MIN | - | - | - | - | - | 0.000 | 0.591 | 0.385 | 0.200 | 0.010 | - | - |
| MEAN | - | - | - | - | - | 1.513 | 0.979 | 0.479 | 0.740 | 0.077 | - | - |
| MAX | - | - | - | - | - | 3.180 | 2.000 | 0.672 | 1.149 | 0.178 | - | - |

**MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | 98.425 | 98.453 | - | - | - |
| 2 | - | - | - | - | - | - | 98.625 P | 98.414 | 98.485 | - | - | - |
| 3 | - | - | - | - | - | - | 98.612 | 98.403 | 98.507 | - | - | - |
| 4 | - | - | - | - | - | - | 98.594 | 98.399 | 98.518 | - | - | - |
| 5 | - | - | - | - | - | - | 98.578 | 98.395 | 98.521 | - | - | - |
| 6 | - | - | - | - | - | - | 98.563 | 98.389 | 98.522 | - | - | - |
| 7 | - | - | - | - | - | - | 98.548 | 98.382 | 98.521 | - | - | - |
| 8 | - | - | - | - | - | - | 98.533 | 98.377 | 98.516 | - | - | - |
| 9 | - | - | - | - | - | - | 98.519 | 98.371 | 98.514 P | - | - | - |
| 10 | - | - | - | - | - | - | 98.508 | 98.369 | - | - | - | - |
| 11 | - | - | - | - | - | - | 98.498 | 98.367 | - | - | - | - |
| 12 | - | - | - | - | - | - | 98.488 | 98.377 | - | - | - | - |
| 13 | - | - | - | - | - | - | 98.481 | 98.379 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.471 | 98.379 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.462 | 98.374 | - | - | - | - |
| 16 | - | - | - | - | - | - | 98.453 | 98.371 | - | - | - | - |
| 17 | - | - | - | - | - | - | 98.448 | 98.366 | - | - | - | - |
| 18 | - | - | - | - | - | - | 98.442 | 98.363 | - | - | - | - |
| 19 | - | - | - | - | - | - | 98.442 | 98.356 | - | - | - | - |
| 20 | - | - | - | - | - | - | 98.436 | 98.352 | - | - | - | - |
| 21 | - | - | - | - | - | - | 98.430 | 98.347 | - | - | - | - |
| 22 | - | - | - | - | - | - | 98.423 | 98.345 | - | - | - | - |
| 23 | - | - | - | - | - | - | 98.415 | 98.347 | - | - | - | - |
| 24 | - | - | - | - | - | - | 98.412 | 98.347 | - | - | - | - |
| 25 | - | - | - | - | - | - | 98.405 | 98.347 | - | - | - | - |
| 26 | - | - | - | - | - | - | 98.423 | 98.344 | - | - | - | - |
| 27 | - | - | - | - | - | - | 98.424 | 98.350 | - | - | - | - |
| 28 | - | - | - | - | - | - | 98.424 | 98.351 | - | - | - | - |
| 29 | - | - | - | - | - | - | 98.425 | 98.365 | - | - | - | - |
| 30 | - | - | - | - | - | - | 98.426 | 98.392 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.421 | 98.422 | - | - | - | - |
| MIN | - | - | - | - | - | - | 98.405 | 98.344 | 98.453 | - | - | - |
| MEAN | - | - | - | - | - | - | 98.478 | 98.373 | 98.506 | - | - | - |
| MAX | - | - | - | - | - | - | 98.625 | 98.425 | 98.522 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Ogama Outflow

LOCATION: Outlet of Ogama Lake

COORDINATES: 435648 m E, 7555130 m N (NAD 83)

MEASUREMENT DATE: 23 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:03h

MEASUREMENT END TIME:12:34 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.15 | | | 0.00 | 0.000 |
| 2 | 2.0 | | 0.18 | | | 0.00 | 0.000 |
| 3 | 4.0 | | 0.23 | | | 0.02 | 0.009 |
| 4 | 6.0 | | 0.26 | | | 0.02 | 0.010 |
| 5 | 8.0 | | 0.14 | | | 0.03 | 0.008 |
| 6 | 10.0 | | 0.09 | | | 0.03 | 0.005 |
| 7 | 12.0 | | 0.18 | | | 0.02 | 0.007 |
| 8 | 14.0 | | 0.13 | | | 0.04 | 0.010 |
| 9 | 16.0 | | 0.16 | | | 0.06 | 0.019 |
| 10 | 18.0 | | 0.06 | | | 0.14 | 0.017 |
| 11 | 20.0 | | 0.20 | | | 0.03 | 0.012 |
| 12 | 22.0 | | 0.28 | | | 0.03 | 0.017 |
| 13 | 24.0 | | 0.31 | | | 0.06 | 0.037 |
| 14 | 26.0 | | 0.16 | | | 0.19 | 0.061 |
| 15 | 28.0 | | 0.22 | | | 0.02 | 0.007 |
| 16 | 29.0 | | 0.24 | | | 0.32 | 0.077 |
| 17 | 30.0 | | 0.37 | | | 0.70 | 0.259 |
| 18 | 31.0 | | 0.55 | | | 0.69 | 0.380 |
| 19 | 32.0 | | 0.60 | | | 0.55 | 0.330 |
| 20 | 33.0 | | 0.72 | | | 0.74 | 0.533 |
| 21 | 34.0 | | 0.61 | | | 0.77 | 0.470 |
| 22 | 35.0 | | 0.76 | 0.43 | 0.80 | | 0.467 |
| 23 | 36.0 | | 0.78 | 0.84 | 0.83 | | 0.651 |
| 24 | 37.0 | | 0.28 | | | 0.05 | 0.021 |
| 25 | 39.0 | | 0.13 | | | 0.00 | 0.000 |
| Left Bank | 41.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **3.408** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Ogama Outflow

LOCATION: Outlet of Ogama Lake

COORDINATES: 435648 m E, 7555130 m N (NAD 83)

MEASUREMENT DATE: 2 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 14:05 h

MEASUREMENT END TIME:15:48 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 24.0 | | 0.09 | | | 0.00 | 0.000 |
| 2 | 22.0 | | 0.10 | | | 0.01 | 0.003 |
| 3 | 18.0 | | 0.30 | | | 0.02 | 0.015 |
| 4 | 17.0 | | 0.38 | | | 0.08 | 0.023 |
| 5 | 16.5 | | 0.38 | | | 0.20 | 0.038 |
| 6 | 16.0 | | 0.42 | | | 0.50 | 0.105 |
| 7 | 15.5 | | 0.47 | | | 0.43 | 0.101 |
| 8 | 15.0 | | 0.52 | | | 0.45 | 0.117 |
| 9 | 14.5 | | 0.50 | | | 0.40 | 0.100 |
| 10 | 14.0 | | 0.50 | | | 0.43 | 0.108 |
| 11 | 13.5 | | 0.60 | | | 0.56 | 0.168 |
| 12 | 13.0 | | 0.82 | 0.63 | 0.65 | | 0.262 |
| 13 | 12.5 | | 0.86 | 0.74 | 0.76 | | 0.323 |
| 14 | 12.0 | | 0.84 | 0.61 | 0.57 | | 0.248 |
| 15 | 11.5 | | 0.66 | | | 0.46 | 0.152 |
| 16 | 11.0 | | 0.56 | | | 0.34 | 0.095 |
| 17 | 10.5 | | 0.48 | | | 0.47 | 0.113 |
| 18 | 10.0 | | 0.48 | | | 0.38 | 0.091 |
| 19 | 9.5 | | 0.42 | | | 0.31 | 0.065 |
| 20 | 9.0 | | 0.36 | | | 0.20 | 0.054 |
| 21 | 8.0 | | 0.30 | | | 0.13 | 0.039 |
| 22 | 7.0 | | 0.30 | | | 0.01 | 0.003 |
| 23 | 6.0 | | 0.23 | | | 0.10 | 0.023 |
| 24 | 5.0 | | 0.26 | | | 0.05 | 0.013 |
| 25 | 4.0 | | 0.20 | | | 0.00 | 0.000 |
| Left Bank | 1.9 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **2.258** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Ogama Outflow

LOCATION: Outlet of Ogama Lake

COORDINATES: 435648 m E, 7555130 m N (NAD 83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 14:26 h

MEASUREMENT END TIME:15:40 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.2 | | 0.26 | | | 0.06 | 0.003 |
| 3 | 0.4 | | 0.30 | | | 0.12 | 0.007 |
| 4 | 0.6 | | 0.31 | | | 0.13 | 0.008 |
| 5 | 0.8 | | 0.28 | | | 0.27 | 0.015 |
| 6 | 1.0 | | 0.42 | | | 0.35 | 0.029 |
| 7 | 1.2 | | 0.42 | | | 0.40 | 0.034 |
| 8 | 1.4 | | 0.42 | | | 0.41 | 0.034 |
| 9 | 1.6 | | 0.42 | | | 0.54 | 0.045 |
| 10 | 1.8 | | 0.48 | | | 0.53 | 0.051 |
| 11 | 2.0 | | 0.52 | | | 0.55 | 0.057 |
| 12 | 2.2 | | 0.53 | | | 0.54 | 0.057 |
| 13 | 2.4 | | 0.46 | | | 0.52 | 0.048 |
| 14 | 2.6 | | 0.64 | | | 0.42 | 0.054 |
| 15 | 2.8 | | 0.70 | | | 0.32 | 0.045 |
| 16 | 3.0 | | 0.42 | | | 0.23 | 0.017 |
| Left Bank | 3.2 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.505** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Ogama Outflow

LOCATION: Outlet of Ogama Lake

COORDINATES: 435648 m E, 7555130 m N (NAD 83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / HL

MEASUREMENT START TIME: 15:10 h

MEASUREMENT END TIME:16:00 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.5 | | 0.16 | | | 0.03 | 0.002 |
| 3 | 1.0 | | 0.28 | | | 0.06 | 0.008 |
| 4 | 1.5 | | 0.18 | | | 0.04 | 0.004 |
| 5 | 2.0 | | 0.16 | | | 0.07 | 0.006 |
| 6 | 2.5 | | 0.16 | | | 0.06 | 0.005 |
| 7 | 3.0 | | 0.20 | | | 0.07 | 0.007 |
| 8 | 3.5 | | 0.38 | | | 0.06 | 0.011 |
| 9 | 4.0 | | 0.46 | | | 0.14 | 0.032 |
| 10 | 4.5 | | 0.56 | | | 0.68 | 0.190 |
| 11 | 5.0 | | 0.74 | 1.05 | 0.41 | | 0.216 |
| 12 | 5.3 | | 0.78 | 0.94 | 0.48 | | 0.166 |
| 13 | 5.6 | | 0.84 | 0.84 | 0.75 | | 0.200 |
| 14 | 5.9 | | 0.90 | 0.84 | 0.58 | | 0.160 |
| 15 | 6.1 | | 0.36 | | | 0.65 | 0.047 |
| Left Bank | 6.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.055** |

# PATCH LAKE AND OUTFLOW HYDROMETRIC STATION

**H81**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on the north bank of the outflow bay of Patch Lake, approximately 200 m upstream of the outflow to PO Lake.

| Operational: | 2006 | 2007 | 2008 | 2009 |
|---|---|---|---|---|
| | 1/6-9/9 | 23/5-12/9 | 21/6-9/9 | |

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 30.0 km²

Coordinates: UTM: 435993 m E, 7549169 m N (Zone 13W NAD83) Lat/Long: 68°02'57" N, 106°32'04" W

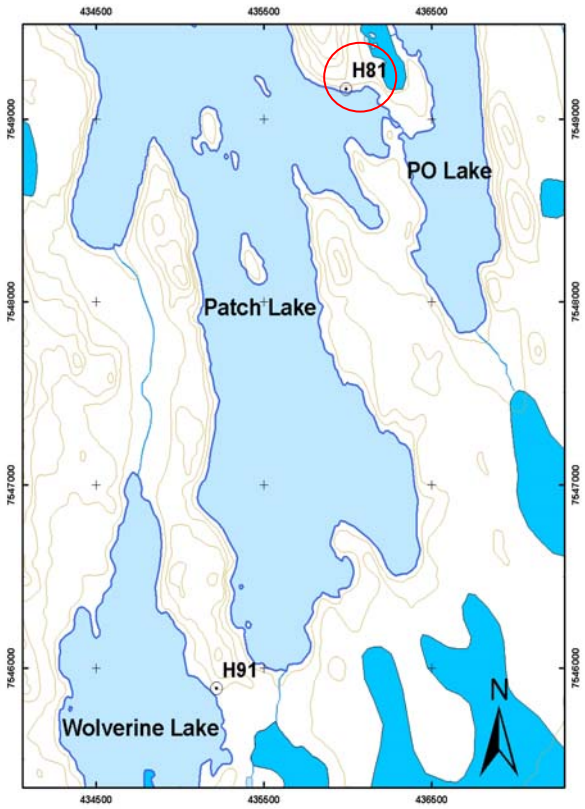
Instruments: Optimum Instruments Datalogger, Keller Transducer

Aerial view of Station H81 looking northeast.

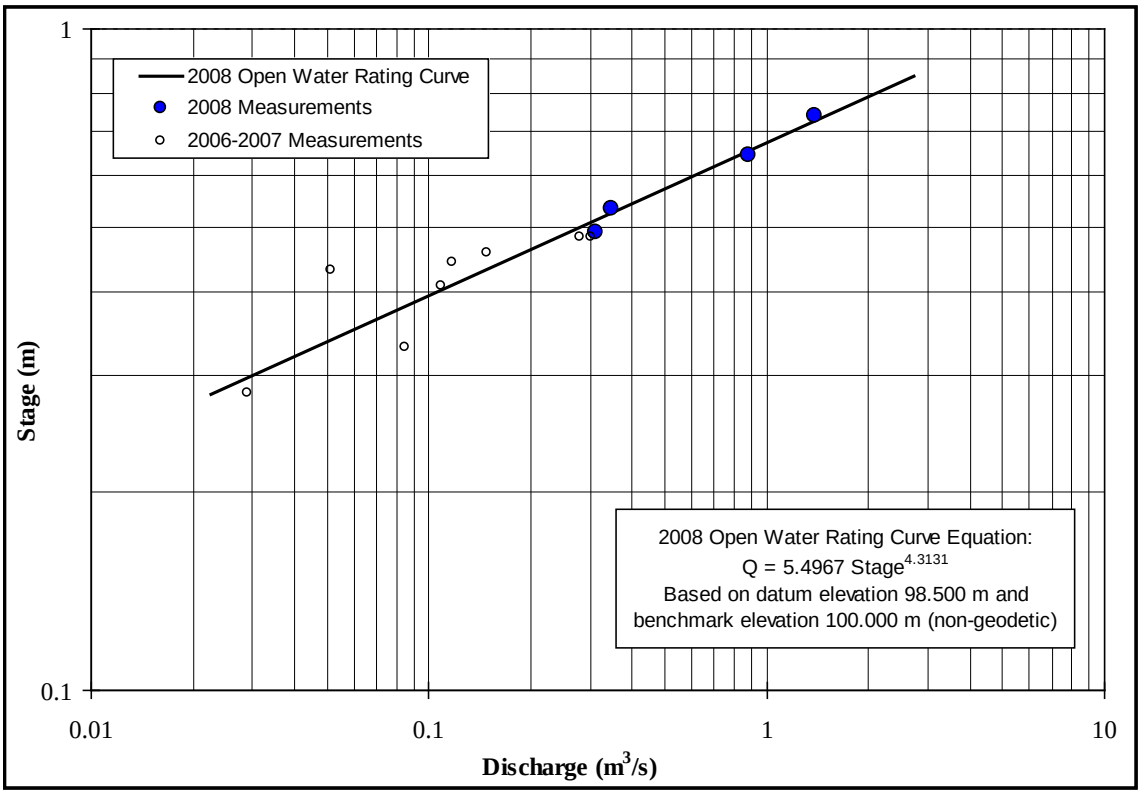
Station H81 looking southeast to outflow channel.

Aerial view of Station H81 looking west.

Station H81 looking west.




NTS Mapping of Area.




**Patch Outflow Station H81 – Stage-Discharge Rating Curve (2008)**

## Patch Outflow Station H81 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 21-Jun-2008 10:05 | 99.239 | 1.002 | 98.237 | 98.198 | 0.739 | 1.386 |
| 01-Jul-2008 11:05 | 99.144 | 0.948 | 98.196 | | 0.644 | 0.882 |
| 12-Aug-2008 08:56 | 98.994 | 0.815 | 98.179 | | 0.494 | 0.310 |
| 09-Sep-2008 13:30 | 99.035 | 0.855 | 98.180 | | 0.535 | 0.348 |

## H81 Patch Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | 0.006 E | 0.827 | 0.381 | 0.350 | 0.090 E | - | - |
| 2 | - | - | - | - | - | 0.009 E | 0.780 | 0.370 | 0.390 | 0.071 E | - | - |
| 3 | - | - | - | - | - | 0.013 E | 0.739 | 0.360 | 0.417 | 0.057 E | - | - |
| 4 | - | - | - | - | - | 0.018 E | 0.699 | 0.355 | 0.437 | 0.045 E | - | - |
| 5 | - | - | - | - | - | 0.019 E | 0.661 | 0.358 | 0.444 | 0.034 E | - | - |
| 6 | - | - | - | - | - | 0.029 E | 0.627 | 0.346 | 0.448 | 0.023 E | - | - |
| 7 | - | - | - | - | - | 0.040 E | 0.592 | 0.326 | 0.450 | 0.016 E | - | - |
| 8 | - | - | - | - | - | 0.060 E | 0.559 | 0.305 | 0.446 | 0.008 E | - | - |
| 9 | - | - | - | - | - | 0.099 E | 0.537 | 0.296 | 0.436 P | - | - | - |
| 10 | - | - | - | - | - | 0.176 E | 0.507 | 0.281 | 0.427 E | - | - | - |
| 11 | - | - | - | - | - | 0.270 E | 0.490 | 0.290 | 0.414 E | - | - | - |
| 12 | - | - | - | - | - | 0.359 E | 0.487 | 0.309 | 0.401 E | - | - | - |
| 13 | - | - | - | - | - | 0.483 E | 0.489 | 0.298 | 0.388 E | - | - | - |
| 14 | - | - | - | - | - | 0.573 E | 0.472 | 0.286 | 0.371 E | - | - | - |
| 15 | - | - | - | - | - | 0.700 E | 0.451 | 0.285 | 0.354 E | - | - | - |
| 16 | - | - | - | - | - | 0.816 E | 0.431 | 0.280 | 0.337 E | - | - | - |
| 17 | - | - | - | - | - | 0.959 E | 0.420 | 0.282 | 0.320 E | - | - | - |
| 18 | - | - | - | - | - | 1.088 E | 0.414 | 0.260 | 0.303 E | - | - | - |
| 19 | - | - | - | - | - | 1.165 E | 0.415 | 0.247 | 0.286 E | - | - | - |
| 20 | - | - | - | - | - | 1.190 E | 0.423 | 0.241 | 0.269 E | - | - | - |
| 21 | - | - | - | - | - | 1.199 P | 0.414 | 0.228 | 0.252 E | - | - | - |
| 22 | - | - | - | - | - | 1.190 | 0.420 | 0.218 | 0.235 E | - | - | - |
| 23 | - | - | - | - | - | 1.163 | 0.402 | 0.232 | 0.218 E | - | - | - |
| 24 | - | - | - | - | - | 1.127 | 0.373 | 0.226 | 0.201 E | - | - | - |
| 25 | - | - | - | - | - | 1.085 | 0.382 | 0.214 | 0.184 E | - | - | - |
| 26 | - | - | - | - | - | 1.018 | 0.422 | 0.203 | 0.167 E | - | - | - |
| 27 | - | - | - | - | - | 0.954 | 0.416 | 0.222 | 0.150 E | - | - | - |
| 28 | - | - | - | - | - | 0.918 | 0.405 | 0.229 | 0.134 E | - | - | - |
| 29 | - | - | - | - | - | 0.888 | 0.397 | 0.243 | 0.120 E | - | - | - |
| 30 | - | - | - | - | - | 0.867 | 0.391 | 0.271 | 0.102 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.388 | 0.306 | - | - | - | - |
| MIN | - | - | - | - | - | 0.006 | 0.373 | 0.203 | 0.102 | 0.008 | - | - |
| MEAN | - | - | - | - | - | 0.616 | 0.498 | 0.282 | 0.315 | 0.043 | - | - |
| MAX | - | - | - | - | - | 1.199 | 0.827 | 0.381 | 0.450 | 0.090 | - | - |

**MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 99.145 | 99.039 | 99.028 | - | - | - |
| 2 | - | - | - | - | - | - | 99.136 | 99.035 | 99.042 | - | - | - |
| 3 | - | - | - | - | - | - | 99.128 | 99.032 | 99.050 | - | - | - |
| 4 | - | - | - | - | - | - | 99.120 | 99.030 | 99.056 | - | - | - |
| 5 | - | - | - | - | - | - | 99.112 | 99.031 | 99.058 | - | - | - |
| 6 | - | - | - | - | - | - | 99.104 | 99.027 | 99.059 | - | - | - |
| 7 | - | - | - | - | - | - | 99.096 | 99.019 | 99.060 | - | - | - |
| 8 | - | - | - | - | - | - | 99.089 | 99.012 | 99.058 | - | - | - |
| 9 | - | - | - | - | - | - | 99.083 | 99.008 | 99.056 P | - | - | - |
| 10 | - | - | - | - | - | - | 99.076 | 99.002 | - | - | - | - |
| 11 | - | - | - | - | - | - | 99.071 | 99.005 | - | - | - | - |
| 12 | - | - | - | - | - | - | 99.070 | 99.013 | - | - | - | - |
| 13 | - | - | - | - | - | - | 99.071 | 99.009 | - | - | - | - |
| 14 | - | - | - | - | - | - | 99.066 | 99.004 | - | - | - | - |
| 15 | - | - | - | - | - | - | 99.060 | 99.003 | - | - | - | - |
| 16 | - | - | - | - | - | - | 99.054 | 99.001 | - | - | - | - |
| 17 | - | - | - | - | - | - | 99.051 | 99.002 | - | - | - | - |
| 18 | - | - | - | - | - | - | 99.049 | 98.993 | - | - | - | - |
| 19 | - | - | - | - | - | - | 99.049 | 98.987 | - | - | - | - |
| 20 | - | - | - | - | - | - | 99.052 | 98.984 | - | - | - | - |
| 21 | - | - | - | - | - | - | 99.049 | 98.978 | - | - | - | - |
| 22 | - | - | - | - | - | - | 99.051 | 98.973 | - | - | - | - |
| 23 | - | - | - | - | - | 99.198 P | 99.045 | 98.980 | - | - | - | - |
| 24 | - | - | - | - | - | 99.192 | 99.036 | 98.977 | - | - | - | - |
| 25 | - | - | - | - | - | 99.186 | 99.039 | 98.971 | - | - | - | - |
| 26 | - | - | - | - | - | 99.176 | 99.052 | 98.965 | - | - | - | - |
| 27 | - | - | - | - | - | 99.166 | 99.050 | 98.975 | - | - | - | - |
| 28 | - | - | - | - | - | 99.160 | 99.046 | 98.978 | - | - | - | - |
| 29 | - | - | - | - | - | 99.155 | 99.044 | 98.985 | - | - | - | - |
| 30 | - | - | - | - | - | 99.152 | 99.042 | 98.998 | - | - | - | - |
| 31 | - | - | - | - | - | - | 99.041 | 99.012 | - | - | - | - |
| MIN | - | - | - | - | - | 99.152 | 99.036 | 98.965 | 99.028 | - | - | - |
| MEAN | - | - | - | - | - | 99.173 | 99.070 | 99.001 | 99.052 | - | - | - |
| MAX | - | - | - | - | - | 99.198 | 99.145 | 99.039 | 99.060 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Patch Outflow

LOCATION: Outlet of Patch Lake

COORDINATES: 435993 m E, 7549169 m N (NAD 83)

MEASUREMENT DATE: 21 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: AG / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:00 h

MEASUREMENT END TIME:12:10 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.06 | | | 0.00 | 0.000 |
| 3 | 2.0 | | 0.16 | | | 0.02 | 0.003 |
| 4 | 3.0 | | 0.25 | | | 0.03 | 0.008 |
| 5 | 4.0 | | 0.20 | | | 0.02 | 0.004 |
| 6 | 5.0 | | 0.42 | | | 0.21 | 0.088 |
| 7 | 6.0 | | 0.42 | | | 0.24 | 0.101 |
| 8 | 7.0 | | 0.47 | | | 0.23 | 0.108 |
| 9 | 8.0 | | 0.50 | | | 0.52 | 0.260 |
| 10 | 9.0 | | 0.70 | | | 0.47 | 0.329 |
| 11 | 10.0 | | 0.43 | | | 0.61 | 0.262 |
| 12 | 11.0 | | 0.38 | | | 0.43 | 0.163 |
| 13 | 12.0 | | 0.32 | | | 0.14 | 0.045 |
| 14 | 13.0 | | 0.25 | | | 0.06 | 0.015 |
| 15 | 14.0 | | 0.05 | | | 0.00 | 0.000 |
| Left Bank | 22.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.386** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Patch Outflow

LOCATION: Outlet of Patch Lake

COORDINATES: 435993 m E, 7549169 m N (NAD 83)

MEASUREMENT DATE: 3 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: AG / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:03h

MEASUREMENT END TIME:11:34 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 8.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 7.0 | | 0.21 | | | 0.01 | 0.002 |
| 3 | 6.5 | | 0.26 | | | 0.27 | 0.035 |
| 4 | 6.0 | | 0.32 | | | 0.29 | 0.032 |
| 5 | 5.8 | | 0.38 | | | 0.32 | 0.024 |
| 6 | 5.6 | | 0.58 | | | 0.32 | 0.037 |
| 7 | 5.4 | | 0.65 | | | 0.32 | 0.042 |
| 8 | 5.2 | | 0.65 | | | 0.51 | 0.066 |
| 9 | 5.0 | | 0.70 | | | 0.35 | 0.049 |
| 10 | 4.8 | | 0.74 | | | 0.32 | 0.047 |
| 11 | 4.6 | | 0.75 | | | 0.41 | 0.061 |
| 12 | 4.4 | | 0.75 | | | 0.56 | 0.084 |
| 13 | 4.2 | | 0.78 | | | 0.57 | 0.089 |
| 14 | 4.0 | | 0.78 | | | 0.49 | 0.076 |
| 15 | 3.8 | | 0.79 | | | 0.48 | 0.076 |
| 16 | 3.6 | | 0.79 | | | 0.39 | 0.062 |
| 17 | 3.4 | | 0.63 | | | 0.38 | 0.048 |
| 18 | 3.2 | | 0.58 | | | 0.34 | 0.039 |
| 19 | 3.0 | | 0.47 | | | 0.09 | 0.008 |
| 20 | 2.8 | | 0.37 | | | 0.02 | 0.001 |
| 21 | 2.6 | | 0.27 | | | 0.01 | 0.001 |
| Left Bank | 1.9 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.882** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Patch Outflow

LOCATION: Outlet of Patch Lake

COORDINATES: 435993 m E, 7549169 m N (NAD 83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: AG / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:03h

MEASUREMENT END TIME:11:34 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.10 | | | 0.01 | 0.001 |
| 3 | 2.0 | | 0.18 | | | 0.02 | 0.004 |
| 4 | 3.0 | | 0.22 | | | 0.07 | 0.015 |
| 5 | 4.0 | | 0.28 | | | 0.08 | 0.017 |
| 6 | 4.5 | | 0.30 | | | 0.15 | 0.018 |
| 7 | 4.8 | | 0.30 | | | 0.18 | 0.019 |
| 8 | 5.2 | | 0.32 | | | 0.36 | 0.040 |
| 9 | 5.5 | | 0.32 | | | 0.58 | 0.056 |
| 10 | 5.8 | | 0.32 | | | 0.43 | 0.041 |
| 11 | 6.1 | | 0.32 | | | 0.47 | 0.045 |
| 12 | 6.4 | | 0.32 | | | 0.36 | 0.035 |
| 13 | 6.7 | | 0.30 | | | 0.10 | 0.009 |
| 14 | 7.0 | | 0.28 | | | 0.05 | 0.009 |
| 15 | 8.0 | | 0.10 | | | 0.01 | 0.001 |
| Left Bank | 8.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.310** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Patch Outflow

LOCATION: Outlet of Patch Lake

COORDINATES: 435993 m E, 7549169 m N (NAD83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / HL

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 12:57 h

MEASUREMENT END TIME: 13:28 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 0.5 | | 0.10 | | | 0.02 | 0.001 |
| 3 | 1.0 | | 0.20 | | | 0.09 | 0.009 |
| 4 | 1.5 | | 0.24 | | | 0.09 | 0.011 |
| 5 | 2.0 | | 0.28 | | | 0.09 | 0.013 |
| 6 | 2.5 | | 0.28 | | | 0.08 | 0.011 |
| 7 | 3.0 | | 0.34 | | | 0.07 | 0.012 |
| 8 | 3.5 | | 0.32 | | | 0.07 | 0.011 |
| 9 | 4.0 | | 0.34 | | | 0.06 | 0.010 |
| 10 | 4.5 | | 0.38 | | | 0.08 | 0.015 |
| 11 | 5.0 | | 0.46 | | | 0.07 | 0.013 |
| 12 | 5.3 | | 0.42 | | | 0.26 | 0.033 |
| 13 | 5.6 | | 0.46 | | | 0.45 | 0.062 |
| 14 | 5.9 | | 0.48 | | | 0.43 | 0.062 |
| 15 | 6.2 | | 0.48 | | | 0.38 | 0.055 |
| 16 | 6.5 | | 0.36 | | | 0.10 | 0.011 |
| 17 | 6.8 | | 0.30 | | | 0.09 | 0.008 |
| 18 | 7.1 | | 0.22 | | | 0.08 | 0.006 |
| 19 | 7.5 | | 0.18 | | | 0.05 | 0.005 |
| Right Bank | 8.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.348** |

# P.O. OUTFLOW HYDROMETRIC STATION

# H89

FACTSHEET

## *LOCATION AND PURPOSE*

Located on the right bank of the outlet channel, on top of an embedded boulder.

| Operational: | 2007<br>14/6-14/9 | 2008<br>21/6-9/9 | 2009 |
|---|---|---|---|

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 64.9 km$^2$

Coordinates: UTM: 436565 m E, 7550014 m N (Zone 13W NAD83) Lat/Long: 68°03'26" N, 106°31'16" W

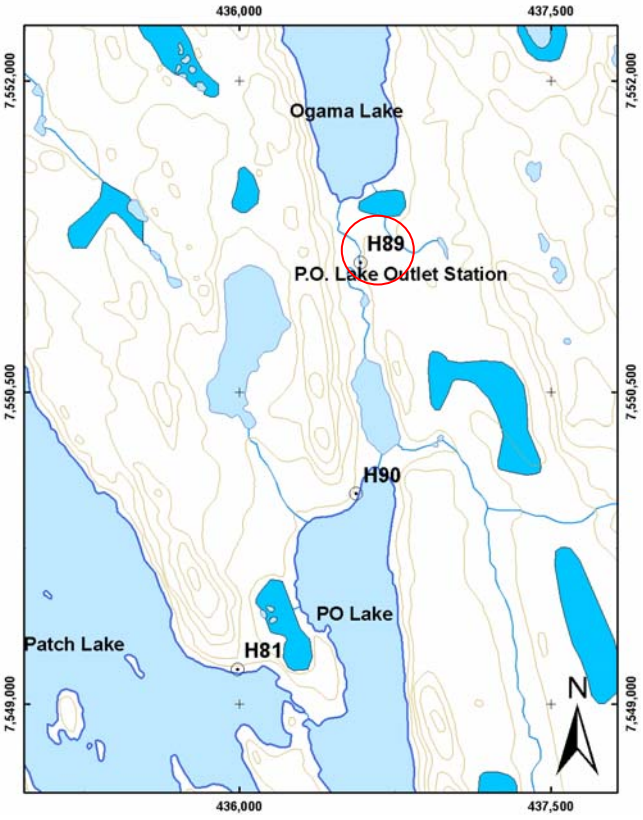
Instruments: Optimum Instruments Datalogger, Keller Transducer

Downstream view of Station H89 with old staff gauge.

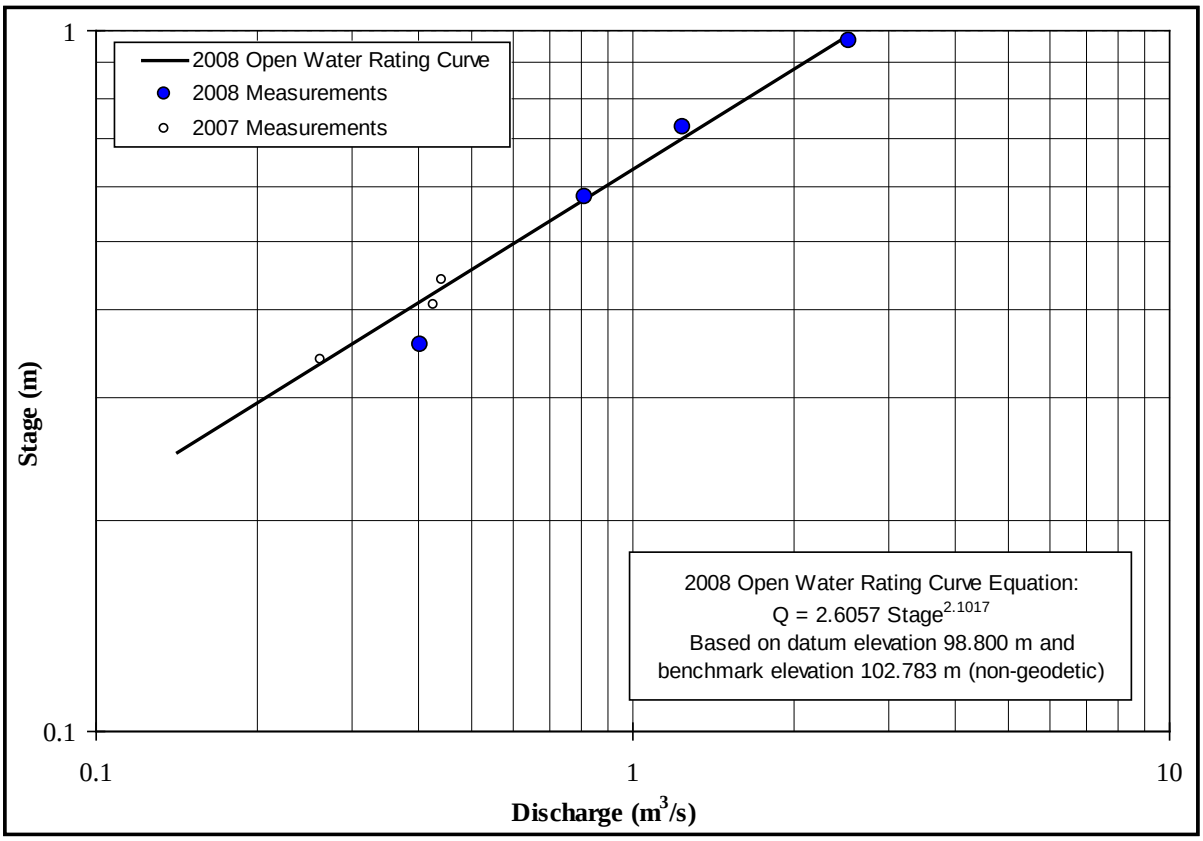
Upstream view with location of the temporary benchmark.

Aerial view of Station H89, looking southeast.

Station H89 looking north (downstream).




NTS Mapping of Area.




**P.O. Outflow Station H89 – Stage-Discharge Rating Curve (2008)**

## P.O. Outflow Station H89 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 22-Jun-2008 14:45 | 99.769 | 1.163 | 98.606 | 98.593 | 0.969 | 2.531 |
| 04-Jul-2008 11:05 | 99.530 | 0.949 | 98.581 | | 0.730 | 1.242 |
| 12-Aug-2008 11:30 | 99.156 | 0.622 | 98.534 | | 0.356 | 0.400 |
| 09-Sep-2008 16:29 | 99.381 | 0.771 | 98.610 | | 0.581 | 0.816 |

**H89 P.O. Outflow – 2008**
**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 1.646 | 0.567 | 0.913 | 0.122 E | - | - |
| 2 | - | - | - | - | - | - | 1.564 | 0.520 | 1.064 | 0.099 E | - | - |
| 3 | - | - | - | - | - | 0.009 E | 1.478 | 0.477 | 1.071 | 0.076 E | - | - |
| 4 | - | - | - | - | - | 0.016 E | 1.402 | 0.459 | 1.015 | 0.053 E | - | - |
| 5 | - | - | - | - | - | 0.020 E | 1.316 | 0.451 | 0.958 | 0.040 E | - | - |
| 6 | - | - | - | - | - | 0.030 E | 1.245 | 0.437 | 0.905 | 0.030 E | - | - |
| 7 | - | - | - | - | - | 0.050 E | 1.172 | 0.419 | 0.854 | 0.027 E | - | - |
| 8 | - | - | - | - | - | 0.070 E | 1.094 | 0.404 | 0.805 | 0.020 E | - | - |
| 9 | - | - | - | - | - | 0.133 E | 1.039 | 0.384 | 0.786 P | 0.011 E | - | - |
| 10 | - | - | - | - | - | 0.200 E | 0.998 | 0.372 | 0.759 E | - | - | - |
| 11 | - | - | - | - | - | 0.350 E | 0.948 | 0.373 | 0.733 E | - | - | - |
| 12 | - | - | - | - | - | 0.520 E | 0.898 | 0.389 | 0.705 E | - | - | - |
| 13 | - | - | - | - | - | 0.700 E | 0.880 | 0.392 | 0.677 E | - | - | - |
| 14 | - | - | - | - | - | 1.000 E | 0.847 | 0.385 | 0.649 E | - | - | - |
| 15 | - | - | - | - | - | 1.200 E | 0.809 | 0.371 | 0.620 E | - | - | - |
| 16 | - | - | - | - | - | 1.450 E | 0.776 | 0.359 | 0.591 E | - | - | - |
| 17 | - | - | - | - | - | 1.740 E | 0.744 | 0.343 | 0.558 E | - | - | - |
| 18 | - | - | - | - | - | 1.980 E | 0.705 | 0.337 | 0.525 E | - | - | - |
| 19 | - | - | - | - | - | 2.190 E | 0.704 | 0.321 | 0.492 E | - | - | - |
| 20 | - | - | - | - | - | 2.400 E | 0.698 | 0.307 | 0.459 E | - | - | - |
| 21 | - | - | - | - | - | 2.451 P | 0.666 | 0.295 | 0.426 E | - | - | - |
| 22 | - | - | - | - | - | 2.377 | 0.632 | 0.287 | 0.393 E | - | - | - |
| 23 | - | - | - | - | - | 2.280 | 0.609 | 0.299 | 0.360 E | - | - | - |
| 24 | - | - | - | - | - | 2.179 | 0.590 | 0.309 | 0.327 E | - | - | - |
| 25 | - | - | - | - | - | 2.063 | 0.569 | 0.312 | 0.294 E | - | - | - |
| 26 | - | - | - | - | - | 1.971 | 0.648 | 0.303 | 0.261 E | - | - | - |
| 27 | - | - | - | - | - | 1.873 | 0.672 | 0.347 | 0.230 E | - | - | - |
| 28 | - | - | - | - | - | 1.796 | 0.664 | 0.393 | 0.199 E | - | - | - |
| 29 | - | - | - | - | - | 1.780 | 0.649 | 0.456 | 0.168 E | - | - | - |
| 30 | - | - | - | - | - | 1.705 | 0.627 | 0.583 | 0.145 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.584 | 0.739 | - | - | - | - |
| MIN | - | - | - | - | - | 0.009 | 0.569 | 0.287 | 0.145 | - | - | - |
| MEAN | - | - | - | - | - | 1.233 | 0.899 | 0.400 | 0.598 | - | - | - |
| MAX | - | - | - | - | - | 2.451 | 1.646 | 0.739 | 1.071 | - | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 99.604 | 99.284 | 99.407 | - | - | - |
| 2 | - | - | - | - | - | - | 99.584 | 99.265 | 99.453 | - | - | - |
| 3 | - | - | - | - | - | - | 99.564 | 99.246 | 99.455 | - | - | - |
| 4 | - | - | - | - | - | - | 99.545 | 99.238 | 99.438 | - | - | - |
| 5 | - | - | - | - | - | - | 99.522 | 99.234 | 99.421 | - | - | - |
| 6 | - | - | - | - | - | - | 99.504 | 99.228 | 99.405 | - | - | - |
| 7 | - | - | - | - | - | - | 99.484 | 99.219 | 99.388 | - | - | - |
| 8 | - | - | - | - | - | - | 99.462 | 99.212 | 99.372 | - | - | - |
| 9 | - | - | - | - | - | - | 99.446 | 99.202 | 99.365 P | - | - | - |
| 10 | - | - | - | - | - | - | 99.433 | 99.196 | - | - | - | - |
| 11 | - | - | - | - | - | - | 99.418 | 99.197 | - | - | - | - |
| 12 | - | - | - | - | - | - | 99.402 | 99.205 | - | - | - | - |
| 13 | - | - | - | - | - | - | 99.397 | 99.206 | - | - | - | - |
| 14 | - | - | - | - | - | - | 99.386 | 99.202 | - | - | - | - |
| 15 | - | - | - | - | - | - | 99.373 | 99.196 | - | - | - | - |
| 16 | - | - | - | - | - | - | 99.362 | 99.189 | - | - | - | - |
| 17 | - | - | - | - | - | - | 99.351 | 99.181 | - | - | - | - |
| 18 | - | - | - | - | - | - | 99.337 | 99.178 | - | - | - | - |
| 19 | - | - | - | - | - | - | 99.337 | 99.169 | - | - | - | - |
| 20 | - | - | - | - | - | - | 99.334 | 99.162 | - | - | - | - |
| 21 | - | - | - | - | - | - | 99.322 | 99.155 | - | - | - | - |
| 22 | - | - | - | - | - | - | 99.310 | 99.150 | - | - | - | - |
| 23 | - | - | - | - | - | 99.738 P | 99.301 | 99.157 | - | - | - | - |
| 24 | - | - | - | - | - | 99.718 | 99.293 | 99.163 | - | - | - | - |
| 25 | - | - | - | - | - | 99.695 | 99.285 | 99.164 | - | - | - | - |
| 26 | - | - | - | - | - | 99.676 | 99.316 | 99.159 | - | - | - | - |
| 27 | - | - | - | - | - | 99.655 | 99.325 | 99.183 | - | - | - | - |
| 28 | - | - | - | - | - | 99.638 | 99.322 | 99.207 | - | - | - | - |
| 29 | - | - | - | - | - | 99.634 | 99.316 | 99.236 | - | - | - | - |
| 30 | - | - | - | - | - | 99.617 | 99.308 | 99.290 | - | - | - | - |
| 31 | - | - | - | - | - | - | 99.291 | 99.349 | - | - | - | - |
| MIN | - | - | - | - | - | 99.617 | 99.285 | 99.150 | 99.365 | - | - | - |
| MEAN | - | - | - | - | - | 99.671 | 99.395 | 99.207 | 99.412 | - | - | - |
| MAX | - | - | - | - | - | 99.738 | 99.604 | 99.349 | 99.455 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Outflow

LOCATION: Outlet of P.O. Lake

COORDINATES: 436584 m E, 7551126 m N (NAD83)

MEASUREMENT DATE: 22 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME:13:45 h

MEASUREMENT END TIME:14:10 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Left Bank | 0.0 | shrubs | 0.00 | | | | |
| 2 | 2.0 | shrubs | 0.27 | | | 0.06 | 0.032 |
| 3 | 4.0 | shrubs | 0.12 | | | 0.04 | 0.010 |
| 4 | 6.0 | shrubs | 0.40 | | | 0.09 | 0.072 |
| 5 | 8.0 | shrubs | 0.38 | | | 0.06 | 0.046 |
| 6 | 10.0 | shrubs | 0.45 | | | 0.25 | 0.225 |
| 7 | 12.0 | shrubs | 0.38 | | | 0.39 | 0.296 |
| 8 | 14.0 | shrubs | 0.16 | | | 0.17 | 0.034 |
| 9 | 14.5 | | 0.96 | 0.96 | 0.93 | | 0.454 |
| 10 | 15.0 | | 0.96 | 1.00 | 1.08 | | 0.499 |
| 11 | 15.5 | | 0.94 | 1.09 | 1.24 | | 0.548 |
| 12 | 16.0 | | 0.94 | 0.99 | 1.05 | | 0.479 |
| 13 | 16.5 | | 1.00 | 0.62 | 0.71 | | 0.333 |
| 14 | 17.0 | shrubs | 0.28 | | | 0.22 | 0.077 |
| 15 | 19.0 | shrubs | 0.30 | | | 0.02 | 0.012 |
| 16 | 21.0 | shrubs | 0.25 | | | 0.07 | 0.035 |
| 17 | 23.0 | shrubs | 0.17 | | | 0.04 | 0.012 |
| 18 | 24.5 | shrubs | 0.05 | | | 0.00 | 0.000 |
| Right Bank | 25.0 | shrubs | 0.00 | | | | |
| | | | | | | | **2.53** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Outflow

LOCATION: Outlet of P.O. Lake

COORDINATES: 436584 m E, 7551126 m N (NAD83)

MEASUREMENT DATE: 4 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME:17:55 h

MEASUREMENT END TIME:18:16 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 7.2 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 6.6 | | 0.89 | 0.19 | 0.12 | | 0.069 |
| 3 | 6.2 | | 0.92 | 0.34 | 0.25 | | 0.109 |
| 4 | 5.8 | | 0.91 | 0.35 | 0.29 | | 0.116 |
| 5 | 5.4 | | 0.93 | 0.35 | 0.26 | | 0.113 |
| 6 | 5.0 | | 0.97 | 0.44 | 0.26 | | 0.136 |
| 7 | 4.6 | | 1.00 | 0.43 | 0.27 | | 0.140 |
| 8 | 4.2 | | 1.06 | 0.47 | 0.22 | | 0.146 |
| 9 | 3.8 | | 0.99 | 0.45 | 0.28 | | 0.145 |
| 10 | 3.4 | | 0.96 | 0.37 | 0.28 | | 0.125 |
| 11 | 3.0 | | 0.90 | 0.32 | 0.19 | | 0.080 |
| 12 | 2.7 | | 0.84 | | | 0.25 | 0.042 |
| 13 | 2.6 | | 0.46 | | | 0.03 | 0.003 |
| 14 | 2.2 | | 0.36 | | | 0.04 | 0.006 |
| 15 | 1.8 | | 0.28 | | | 0.07 | 0.012 |
| Right Bank | 1.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.242** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Outflow

LOCATION: Outlet of P.O. Lake

COORDINATES: 436584 m E, 7551126 m N (NAD83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME:11:30 h

MEASUREMENT END TIME: 12:25

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.20 | | | 0.00 | 0.000 |
| 3 | 1.5 | | 0.46 | | | 0.00 | 0.000 |
| 4 | 1.8 | | 0.56 | | | 0.01 | 0.001 |
| 5 | 2.0 | | 0.58 | | | 0.11 | 0.013 |
| 6 | 2.2 | | 0.58 | | | 0.18 | 0.021 |
| 7 | 2.4 | | 0.64 | | | 0.14 | 0.018 |
| 8 | 2.6 | | 0.67 | | | 0.17 | 0.023 |
| 9 | 2.8 | | 0.70 | | | 0.12 | 0.017 |
| 10 | 3.0 | | 0.70 | | | 0.15 | 0.021 |
| 11 | 3.2 | | 0.70 | | | 0.20 | 0.028 |
| 12 | 3.4 | | 0.72 | | | 0.18 | 0.026 |
| 13 | 3.6 | | 0.68 | | | 0.19 | 0.026 |
| 14 | 3.8 | | 0.66 | | | 0.20 | 0.026 |
| 15 | 4.0 | | 0.64 | | | 0.18 | 0.023 |
| 16 | 4.2 | | 0.63 | | | 0.18 | 0.023 |
| 17 | 4.4 | | 0.62 | | | 0.18 | 0.022 |
| 18 | 4.6 | | 0.60 | | | 0.18 | 0.022 |
| 19 | 4.8 | | 0.60 | | | 0.16 | 0.019 |
| 20 | 5.0 | | 0.60 | | | 0.16 | 0.019 |
| 21 | 5.2 | | 0.61 | | | 0.17 | 0.021 |
| 22 | 5.4 | | 0.60 | | | 0.11 | 0.013 |
| 23 | 5.6 | | 0.56 | | | 0.10 | 0.011 |
| 24 | 5.8 | | 0.50 | | | 0.06 | 0.008 |
| Left Bank | 6.1 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.400** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Outlet

LOCATION: Outlet of P.O. Lake

COORDINATES: 436584 m E, 7551126 m N (NAD83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AK

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 16:28 h

MEASUREMENT END TIME: 16:50 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.28 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.37 | | | 0.00 | 0.000 |
| 3 | 1.2 | | 0.73 | 0.05 | 0.03 | | 0.009 |
| 4 | 1.6 | | 0.80 | 0.31 | 0.16 | | 0.075 |
| 5 | 2.0 | | 0.90 | 0.34 | 0.15 | | 0.088 |
| 6 | 2.4 | | 0.80 | 0.35 | 0.21 | | 0.090 |
| 7 | 2.8 | | 0.82 | 0.36 | 0.28 | | 0.105 |
| 8 | 3.2 | | 0.84 | 0.38 | 0.32 | | 0.118 |
| 9 | 3.6 | | 0.81 | 0.35 | 0.28 | | 0.102 |
| 10 | 4.0 | | 0.80 | 0.31 | 0.30 | | 0.098 |
| 11 | 4.4 | | 0.78 | 0.29 | 0.28 | | 0.089 |
| 12 | 4.8 | | 0.76 | 0.14 | 0.11 | | 0.043 |
| Left Bank | 5.3 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.816** |

# P.O. LAKE
# HYDROMETRIC STATION

**H90**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located on the north bank of the outflow bay of P.O. Lake, approximately 200 m upstream of the narrows and confluence with the unnamed tributary to P.O. Lake.

| Operational: | 2007 | 2008 | 2009 |
|---|---|---|---|
| | 14/6-14/9 | 21/6-9/9 | |

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 34.4 km$^2$

Coordinates: UTM: 436584 m E, 7551126 m N (Zone 13W NAD83) Lat/Long: 68°04'02" N, 106°31'17" W

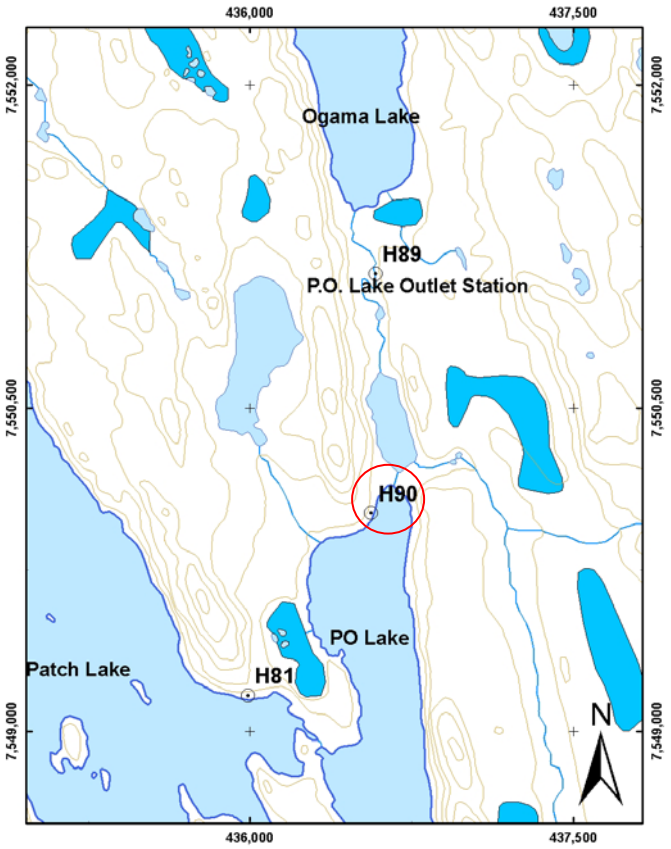
Instruments: Optimum Instruments Datalogger, Keller Transducer

Station H90 looking north to lake outlet.

Station H90 looking southeast.

Station H90 looking east.

Station H90 looking north to lake September 2008.




NTS Mapping of Area.

**Golder Associates**

# PO Lake Station H90 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 21-Jun-2008 14:45 | 99.769 | 1.183 | 98.586 | 98.575 | 1.269 | 1.731 |
| 03-Jul-2008 12:58 | 99.530 | 0.966 | 98.564 | | 1.030 | 1.057 |
| 12-Aug-2008 10:30 | 99.156 | 0.618 | 98.538 | | 0.656 | 0.284 |
| 09-Sep-2008 14:30 | 99.381 | 0.770 | 98.611 | | 0.881 | 0.465 |

**H90 P.O. Lake – 2008**

**MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK EL. 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 99.574 | 99.257 | 99.420 | - | - | - |
| 2 | - | - | - | - | - | - | 99.555 | 99.235 | 99.439 | - | - | - |
| 3 | - | - | - | - | - | - | 99.534 | 99.222 | 99.429 | - | - | - |
| 4 | - | - | - | - | - | - | 99.514 | 99.217 | 99.411 | - | - | - |
| 5 | - | - | - | - | - | - | 99.493 | 99.212 | 99.392 | - | - | - |
| 6 | - | - | - | - | - | - | 99.475 | 99.205 | 99.379 | - | - | - |
| 7 | - | - | - | - | - | - | 99.453 | 99.195 | 99.358 | - | - | - |
| 8 | - | - | - | - | - | - | 99.433 | 99.189 | 99.349 | - | - | - |
| 9 | - | - | - | - | - | - | 99.420 | 99.180 | 99.347 P | - | - | - |
| 10 | - | - | - | - | - | - | 99.406 | 99.175 | - | - | - | - |
| 11 | - | - | - | - | - | - | 99.390 | 99.187 | - | - | - | - |
| 12 | - | - | - | - | - | - | 99.381 | 99.185 | - | - | - | - |
| 13 | - | - | - | - | - | - | 99.372 | 99.188 | - | - | - | - |
| 14 | - | - | - | - | - | - | 99.360 | 99.179 | - | - | - | - |
| 15 | - | - | - | - | - | - | 99.349 | 99.174 | - | - | - | - |
| 16 | - | - | - | - | - | - | 99.337 | 99.166 | - | - | - | - |
| 17 | - | - | - | - | - | - | 99.323 | 99.160 | - | - | - | - |
| 18 | - | - | - | - | - | - | 99.319 | 99.156 | - | - | - | - |
| 19 | - | - | - | - | - | - | 99.315 | 99.146 | - | - | - | - |
| 20 | - | - | - | - | - | - | 99.311 | 99.138 | - | - | - | - |
| 21 | - | - | - | - | - | - | 99.297 | 99.133 | - | - | - | - |
| 22 | - | - | - | - | - | - | 99.287 | 99.135 | - | - | - | - |
| 23 | - | - | - | - | - | 99.710 P | 99.277 | 99.141 | - | - | - | - |
| 24 | - | - | - | - | - | 99.688 | 99.267 | 99.147 | - | - | - | - |
| 25 | - | - | - | - | - | 99.665 | 99.282 | 99.141 | - | - | - | - |
| 26 | - | - | - | - | - | 99.645 | 99.306 | 99.149 | - | - | - | - |
| 27 | - | - | - | - | - | 99.626 | 99.304 | 99.180 | - | - | - | - |
| 28 | - | - | - | - | - | 99.616 | 99.301 | 99.201 | - | - | - | - |
| 29 | - | - | - | - | - | 99.608 | 99.293 | 99.245 | - | - | - | - |
| 30 | - | - | - | - | - | 99.592 | 99.281 | 99.305 | - | - | - | - |
| 31 | - | - | - | - | - | - | 99.266 | 99.360 | - | - | - | - |
| MIN | - | - | - | - | - | 99.592 | 99.266 | 99.133 | 99.347 | - | - | - |
| MEAN | - | - | - | - | - | 99.644 | 99.370 | 99.190 | 99.391 | - | - | - |
| MAX | - | - | - | - | - | 99.710 | 99.574 | 99.360 | 99.439 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Lake

LOCATION: P.O. Lake Narrows

COORDINATES: 436565 m E, 7550014 m N (NAD 83)

MEASUREMENT DATE: 21 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:41 h

MEASUREMENT END TIME:13:57 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 3.0 | | 0.17 | | | 0.00 | 0.000 |
| 3 | 6.0 | | 0.18 | | | 0.01 | 0.005 |
| 4 | 9.0 | | 0.18 | | | 0.00 | 0.000 |
| 5 | 12.0 | | 0.26 | | | 0.02 | 0.016 |
| 6 | 15.0 | | 0.32 | | | 0.02 | 0.019 |
| 7 | 18.0 | | 0.40 | | | 0.15 | 0.180 |
| 8 | 21.0 | | 0.42 | | | 0.18 | 0.227 |
| 9 | 24.0 | | 0.44 | | | 0.16 | 0.211 |
| 10 | 27.0 | | 0.41 | | | 0.17 | 0.209 |
| 11 | 30.0 | | 0.40 | | | 0.14 | 0.126 |
| 12 | 31.5 | | 0.44 | | | 0.16 | 0.088 |
| 13 | 32.5 | | 0.72 | | | 0.20 | 0.144 |
| 14 | 33.5 | | 0.84 | 0.13 | 0.18 | | 0.130 |
| 15 | 34.5 | | 0.50 | | | 0.14 | 0.088 |
| 16 | 36.0 | | 0.44 | | | 0.14 | 0.139 |
| 17 | 39.0 | | 0.41 | | | 0.09 | 0.111 |
| 18 | 42.0 | | 0.38 | | | 0.02 | 0.023 |
| 22 | 45.0 | | 0.26 | | | 0.02 | 0.016 |
| 23 | 48.0 | | 0.24 | | | 0.00 | 0.000 |
| Left Bank | 50.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.73** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Lake

LOCATION: P.O. Lake Narrows

COORDINATES: 436565 m E, 7550014 m N (NAD 83)

MEASUREMENT DATE: 3 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:41 h

MEASUREMENT END TIME:13:57 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 23.0 | | 0.22 | | | 0.00 | 0.000 |
| 2 | 22.0 | | 0.24 | | | 0.01 | 0.002 |
| 3 | 21.0 | | 0.26 | | | 0.04 | 0.010 |
| 4 | 20.0 | | 0.27 | | | 0.12 | 0.032 |
| 5 | 19.0 | | 0.28 | | | 0.13 | 0.036 |
| 6 | 18.0 | | 0.30 | | | 0.10 | 0.030 |
| 7 | 17.0 | | 0.30 | | | 0.13 | 0.039 |
| 8 | 16.0 | | 0.34 | | | 0.17 | 0.043 |
| 9 | 15.5 | | 0.48 | | | 0.27 | 0.065 |
| 10 | 15.0 | | 0.68 | | | 0.29 | 0.099 |
| 11 | 14.5 | | 0.66 | | | 0.32 | 0.106 |
| 12 | 14.0 | | 0.56 | | | 0.22 | 0.062 |
| 13 | 13.5 | | 0.44 | | | 0.19 | 0.042 |
| 14 | 13.0 | | 0.20 | | | 0.20 | 0.030 |
| 15 | 12.0 | | 0.26 | | | 0.20 | 0.052 |
| 16 | 11.0 | | 0.26 | | | 0.24 | 0.062 |
| 17 | 10.0 | | 0.24 | | | 0.24 | 0.058 |
| 18 | 9.0 | | 0.28 | | | 0.21 | 0.059 |
| 19 | 8.0 | | 0.28 | | | 0.23 | 0.064 |
| 20 | 7.0 | | 0.29 | | | 0.28 | 0.081 |
| 21 | 6.0 | | 0.26 | | | 0.18 | 0.047 |
| 22 | 5.0 | | 0.22 | | | 0.12 | 0.026 |
| 23 | 4.0 | | 0.16 | | | 0.06 | 0.007 |
| 24 | 3.5 | | 0.14 | | | 0.06 | 0.004 |
| 25 | 3.0 | | 0.06 | | | 0.00 | 0.000 |
| Left Bank | 1.5 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **1.057** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Lake

LOCATION: P.O. Lake Narrows

COORDINATES: 436565 m E, 7550014 m N (NAD 83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: AG / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:41 h

MEASUREMENT END TIME:13:57 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.06 | | | 0.01 | 0.001 |
| 3 | 2.0 | | 0.14 | | | 0.06 | 0.008 |
| 4 | 3.0 | | 0.12 | | | 0.05 | 0.006 |
| 5 | 4.0 | | 0.16 | | | 0.04 | 0.006 |
| 6 | 5.0 | | 0.12 | | | 0.02 | 0.002 |
| 7 | 6.0 | | 0.12 | | | 0.02 | 0.002 |
| 8 | 7.0 | | 0.20 | | | 0.05 | 0.010 |
| 9 | 8.0 | | 0.20 | | | 0.05 | 0.010 |
| 10 | 9.0 | | 0.30 | | | 0.05 | 0.011 |
| 11 | 9.4 | | 0.52 | | | 0.14 | 0.022 |
| 12 | 9.6 | | 0.50 | | | 0.31 | 0.031 |
| 13 | 9.8 | | 0.50 | | | 0.38 | 0.038 |
| 14 | 10.0 | | 0.53 | | | 0.38 | 0.040 |
| 15 | 10.2 | | 0.52 | | | 0.32 | 0.033 |
| 16 | 10.4 | | 0.53 | | | 0.22 | 0.023 |
| 17 | 10.6 | | 0.53 | | | 0.06 | 0.006 |
| 18 | 10.8 | | 0.50 | | | 0.07 | 0.016 |
| 22 | 11.5 | | 0.30 | | | 0.04 | 0.010 |
| 23 | 12.5 | | 0.24 | | | 0.02 | 0.005 |
| 23 | 13.5 | | 0.16 | | | 0.01 | 0.002 |
| 23 | 15.0 | | 0.15 | | | 0.00 | 0.000 |
| Left Bank | 15.7 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.284** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: P.O. Lake

LOCATION: P.O. Lake Narrows

COORDINATES: 436565 m E, 7550014 m N (NAD 83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / DC

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 13:41 h

MEASUREMENT END TIME:13:57 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.12 | | | 0.01 | 0.001 |
| 3 | 2.0 | | 0.20 | | | 0.05 | 0.010 |
| 4 | 3.0 | | 0.28 | | | 0.05 | 0.014 |
| 5 | 4.0 | | 0.34 | | | 0.03 | 0.010 |
| 6 | 5.0 | | 0.36 | | | 0.03 | 0.011 |
| 7 | 6.0 | | 0.30 | | | 0.03 | 0.009 |
| 8 | 7.0 | | 0.32 | | | 0.03 | 0.010 |
| 9 | 8.0 | | 0.35 | | | 0.03 | 0.011 |
| 10 | 9.0 | | 0.44 | | | 0.03 | 0.013 |
| 11 | 10.0 | | 0.56 | | | 0.03 | 0.013 |
| 12 | 10.5 | | 0.60 | | | 0.03 | 0.009 |
| 13 | 11.0 | | 0.66 | | | 0.12 | 0.036 |
| 14 | 11.4 | | 0.64 | | | 0.35 | 0.090 |
| 15 | 11.8 | | 0.64 | | | 0.34 | 0.087 |
| 16 | 12.2 | | 0.66 | | | 0.22 | 0.058 |
| 17 | 12.6 | | 0.60 | | | 0.08 | 0.019 |
| 18 | 13.0 | | 0.56 | | | 0.03 | 0.012 |
| 19 | 14.0 | | 0.55 | | | 0.04 | 0.022 |
| 20 | 15.0 | | 0.36 | | | 0.02 | 0.007 |
| 21 | 16.0 | | 0.29 | | | 0.03 | 0.009 |
| 22 | 17.0 | | 0.28 | | | 0.03 | 0.008 |
| 23 | 18.0 | | 0.20 | | | 0.01 | 0.003 |
| 24 | 20.0 | | 0.16 | | | 0.01 | 0.002 |
| 25 | 21.0 | | 0.18 | | | 0.01 | 0.002 |
| 26 | 22.0 | | 0.15 | | | 0.00 | 0.000 |
| Left Bank | 25.0 | | 0.00 | | | | 0.000 |
| | | | | | | | **0.465** |

# WINDY LAKE AND OUTFLOW HYDROMETRIC STATION

**H92**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located approximately 100 m upstream, on the left downstream bank of the Windy Lake outflow (north shore).

| Operational: | 2006<br>29/5-8/9 | 2007<br>24/5-15/9 | 2008<br>22/6-9/9 | 2009 |
|---|---|---|---|---|

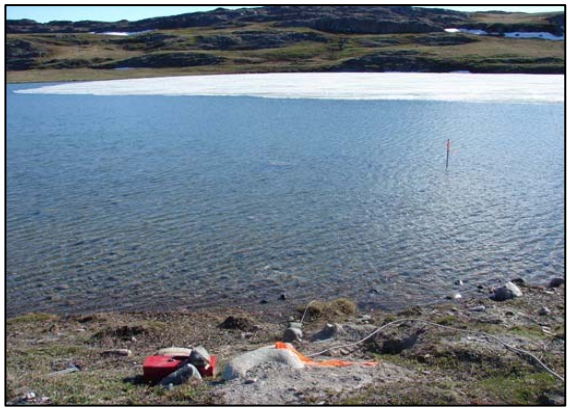
Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 13.9 km$^2$

Coordinates: UTM: 431507 m E, 7555043 m N (Zone 13W NAD83) Lat/Long: 68°06'04" N, 106°38'45" W

Instruments: Optimum Instruments Datalogger, Keller Transducer

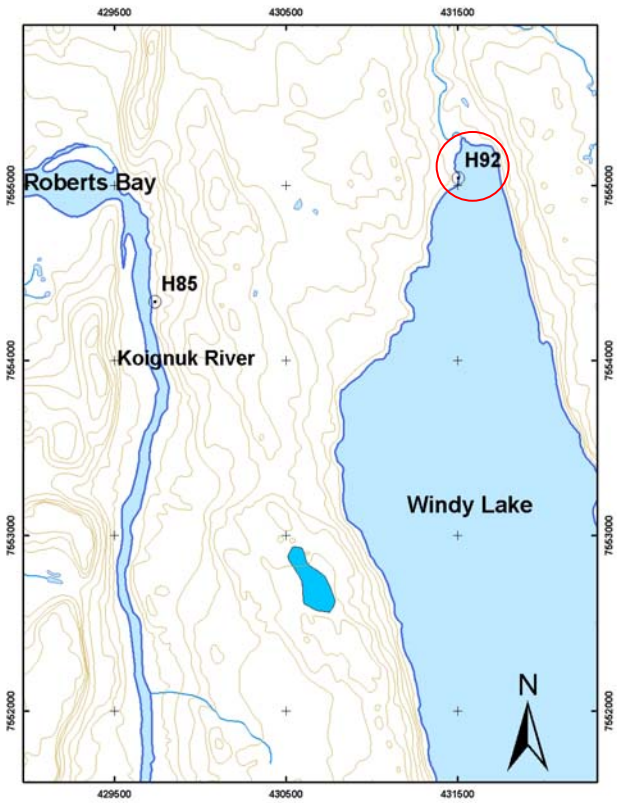
Aerial view of Station H92.

Station H92 upstream view of the outlet channel.

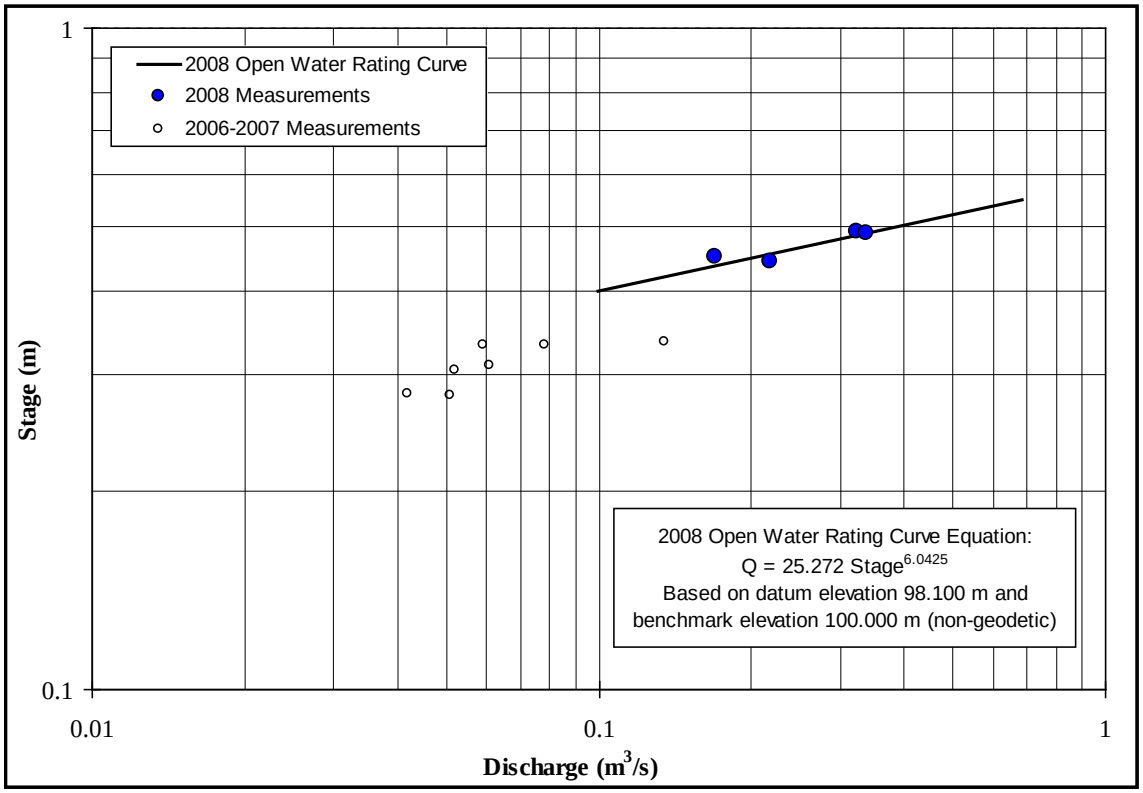


Station H92 benchmark and datalogger location looking east.

Station H92 downstream view of the outlet channel.




NTS Mapping of Area.




**Windy Outflow Station H92 – Stage-Discharge Rating Curve (2008)**

## Windy Outflow Station H92 – Stage-Discharge Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) | Measured Discharge ($m^3/s$) |
|---|---|---|---|---|---|---|
| 22-Jun-2008 09:05 | 98.594 | | | 97.636 | 0.494 | 0.322 |
| 02-Jul-2008 08:45 | 98.590 | 0.941 | 97.649 | | 0.490 | 0.337 |
| 12-Aug-2008 17:20 | 98.552 | 0.925 | 97.627 | | 0.452 | 0.170 |
| 09-Sep-2008 11:30 | 98.544 | 0.913 | 97.631 | | 0.444 | 0.218 |

## H92 Windy Lake and Outflow – 2008

**MEAN DAILY DISCHARGE ($m^3/s$)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | 0.260 | 0.217 | 0.046 E | - | - |
| 2 | - | - | - | - | - | - | 0.294 | 0.248 | 0.228 | 0.037 E | - | - |
| 3 | - | - | - | - | - | - | 0.288 | 0.237 | 0.236 | 0.028 E | - | - |
| 4 | - | - | - | - | - | 0.003 E | 0.279 | 0.232 | 0.229 | 0.022 E | - | - |
| 5 | - | - | - | - | - | 0.004 E | 0.267 | 0.233 | 0.224 | 0.016 E | - | - |
| 6 | - | - | - | - | - | 0.007 E | 0.259 | 0.224 | 0.216 | 0.010 E | - | - |
| 7 | - | - | - | - | - | 0.016 E | 0.248 | 0.216 | 0.206 | 0.006 E | - | - |
| 8 | - | - | - | - | - | 0.028 E | 0.237 | 0.209 | 0.193 | 0.003 E | - | - |
| 9 | - | - | - | - | - | 0.073 E | 0.228 | 0.197 | 0.197 P | - | - | - |
| 10 | - | - | - | - | - | 0.115 E | 0.219 | 0.196 | 0.205 E | - | - | - |
| 11 | - | - | - | - | - | 0.178 E | 0.212 | 0.193 | 0.203 E | - | - | - |
| 12 | - | - | - | - | - | 0.221 E | 0.213 | 0.227 | 0.198 E | - | - | - |
| 13 | - | - | - | - | - | 0.283 E | 0.219 | 0.219 | 0.192 E | - | - | - |
| 14 | - | - | - | - | - | 0.308 E | 0.212 | 0.212 | 0.186 E | - | - | - |
| 15 | - | - | - | - | - | 0.313 E | 0.208 | 0.204 | 0.180 E | - | - | - |
| 16 | - | - | - | - | - | 0.318 E | 0.200 | 0.197 | 0.175 E | - | - | - |
| 17 | - | - | - | - | - | 0.321 E | 0.198 | 0.187 | 0.166 E | - | - | - |
| 18 | - | - | - | - | - | 0.322 E | 0.205 | 0.181 | 0.157 E | - | - | - |
| 19 | - | - | - | - | - | 0.322 E | 0.220 | 0.169 | 0.149 E | - | - | - |
| 20 | - | - | - | - | - | 0.322 E | 0.238 | 0.159 | 0.140 E | - | - | - |
| 21 | - | - | - | - | - | 0.323 E | 0.226 | 0.145 | 0.132 E | - | - | - |
| 22 | - | - | - | - | - | 0.322 E | 0.216 | 0.142 | 0.123 E | - | - | - |
| 23 | - | - | - | - | - | 0.320 E | 0.215 | 0.147 | 0.114 E | - | - | - |
| 24 | - | - | - | - | - | 0.318 E | 0.215 | 0.145 | 0.106 E | - | - | - |
| 25 | - | - | - | - | - | 0.316 E | 0.219 | 0.140 | 0.097 E | - | - | - |
| 26 | - | - | - | - | - | 0.313 E | 0.261 | 0.130 | 0.089 E | - | - | - |
| 27 | - | - | - | - | - | 0.311 E | 0.261 | 0.142 | 0.080 E | - | - | - |
| 28 | - | - | - | - | - | 0.308 E | 0.250 | 0.138 | 0.071 E | - | - | - |
| 29 | - | - | - | - | - | 0.305 E | 0.254 | 0.145 | 0.063 E | - | - | - |
| 30 | - | - | - | - | - | 0.302 E | 0.258 | 0.167 | 0.054 E | - | - | - |
| 31 | - | - | - | - | - | - | 0.246 | 0.187 | - | - | - | - |
| MIN | - | - | - | - | - | 0.003 | 0.198 | 0.130 | 0.054 | 0.003 | - | - |
| MEAN | - | - | - | - | - | 0.233 | 0.236 | 0.188 | 0.161 | 0.021 | - | - |
| MAX | - | - | - | - | - | 0.323 | 0.294 | 0.260 | 0.236 | 0.046 | - | - |

**MEAN DAILY WATER SURFACE ELEVATION (m) BASED ON BENCHMARK ELEVATION 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | - | 98.566 | 98.555 | - | - | - |
| 2 | - | - | - | - | - | - | 98.578 P | 98.564 | 98.559 | - | - | - |
| 3 | - | - | - | - | - | - | 98.577 | 98.562 | 98.561 | - | - | - |
| 4 | - | - | - | - | - | - | 98.574 | 98.560 | 98.559 | - | - | - |
| 5 | - | - | - | - | - | - | 98.571 | 98.560 | 98.557 | - | - | - |
| 6 | - | - | - | - | - | - | 98.569 | 98.558 | 98.555 | - | - | - |
| 7 | - | - | - | - | - | - | 98.565 | 98.555 | 98.551 | - | - | - |
| 8 | - | - | - | - | - | - | 98.562 | 98.552 | 98.546 | - | - | - |
| 9 | - | - | - | - | - | - | 98.559 | 98.548 | 98.548 P | - | - | - |
| 10 | - | - | - | - | - | - | 98.556 | 98.547 | - | - | - | - |
| 11 | - | - | - | - | - | - | 98.553 | 98.546 | - | - | - | - |
| 12 | - | - | - | - | - | - | 98.554 | 98.558 | - | - | - | - |
| 13 | - | - | - | - | - | - | 98.556 | 98.556 | - | - | - | - |
| 14 | - | - | - | - | - | - | 98.553 | 98.553 | - | - | - | - |
| 15 | - | - | - | - | - | - | 98.552 | 98.550 | - | - | - | - |
| 16 | - | - | - | - | - | - | 98.549 | 98.548 | - | - | - | - |
| 17 | - | - | - | - | - | - | 98.548 | 98.544 | - | - | - | - |
| 18 | - | - | - | - | - | - | 98.551 | 98.542 | - | - | - | - |
| 19 | - | - | - | - | - | - | 98.556 | 98.536 | - | - | - | - |
| 20 | - | - | - | - | - | - | 98.562 | 98.532 | - | - | - | - |
| 21 | - | - | - | - | - | - | 98.558 | 98.526 | - | - | - | - |
| 22 | - | - | - | - | - | - | 98.555 | 98.524 | - | - | - | - |
| 23 | - | - | - | - | - | - | 98.554 | 98.526 | - | - | - | - |
| 24 | - | - | - | - | - | - | 98.554 | 98.526 | - | - | - | - |
| 25 | - | - | - | - | - | - | 98.556 | 98.523 | - | - | - | - |
| 26 | - | - | - | - | - | - | 98.569 | 98.518 | - | - | - | - |
| 27 | - | - | - | - | - | - | 98.569 | 98.524 | - | - | - | - |
| 28 | - | - | - | - | - | - | 98.566 | 98.522 | - | - | - | - |
| 29 | - | - | - | - | - | - | 98.567 | 98.526 | - | - | - | - |
| 30 | - | - | - | - | - | - | 98.567 | 98.536 | - | - | - | - |
| 31 | - | - | - | - | - | - | 98.565 | 98.544 | - | - | - | - |
| MIN | - | - | - | - | - | - | 98.548 | 98.518 | 98.546 | - | - | - |
| MEAN | - | - | - | - | - | - | 98.561 | 98.543 | 98.555 | - | - | - |
| MAX | - | - | - | - | - | - | 98.578 | 98.566 | 98.561 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE E – ESTIMATED A – MANUAL MEASUREMENT

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Windy Outflow

LOCATION: Outflow of Windy Lake

COORDINATES: 435222 m E, 7545888 m N (NAD83)

MEASUREMENT DATE: 22 June 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: PE / AH

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 8:50 h

MEASUREMENT END TIME: 9:20 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 0.0 | | 0.04 | | | 0.00 | 0.000 |
| 2 | 2.0 | | 0.16 | | | 0.00 | 0.000 |
| 3 | 4.0 | | 0.17 | | | 0.02 | 0.007 |
| 4 | 6.0 | | 0.28 | | | 0.03 | 0.017 |
| 5 | 8.0 | | 0.44 | | | 0.03 | 0.020 |
| 6 | 9.0 | | 0.54 | | | 0.12 | 0.065 |
| 7 | 10.0 | | 0.62 | | | 0.26 | 0.161 |
| 8 | 11.0 | | 0.50 | | | 0.03 | 0.023 |
| 9 | 13.0 | | 0.30 | | | 0.03 | 0.018 |
| 10 | 15.0 | | 0.22 | | | 0.02 | 0.009 |
| 11 | 17.0 | | 0.16 | | | 0.01 | 0.003 |
| 12 | 19.0 | | 0.08 | | | 0.00 | 0.000 |
| Right Bank | 21.6 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.322** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Windy Outflow

LOCATION: Outflow of Windy Lake

COORDINATES: 435222 m E, 7545888 m N (NAD83)

MEASUREMENT DATE: 2 July 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / AG

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 8:10 h

MEASUREMENT END TIME: 9:25 h

| STATION | DISTANCE FROM LEFT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Left Bank | 3.0 | grass | 0.00 | | | 0.00 | 0.000 |
| 2 | 4.0 | grass | 0.36 | | | 0.00 | 0.000 |
| 3 | 5.0 | grass | 0.35 | | | 0.08 | 0.028 |
| 4 | 6.0 | grass | 0.33 | | | 0.13 | 0.032 |
| 5 | 6.5 | grass | 0.38 | | | 0.13 | 0.025 |
| 6 | 7.0 | | 0.54 | | | 0.17 | 0.037 |
| 7 | 7.3 | | 0.52 | | | 0.26 | 0.041 |
| 8 | 7.6 | | 0.58 | | | 0.31 | 0.054 |
| 9 | 7.9 | | 0.60 | | | 0.30 | 0.054 |
| 10 | 8.2 | | 0.58 | | | 0.29 | 0.050 |
| 11 | 8.5 | | 0.52 | | | 0.26 | 0.041 |
| 12 | 8.8 | | 0.50 | | | 0.24 | 0.036 |
| 13 | 9.1 | | 0.47 | | | 0.15 | 0.025 |
| 14 | 9.5 | grass | 0.46 | | | 0.08 | 0.017 |
| 15 | 10.0 | grass | 0.38 | | | 0.01 | 0.002 |
| 16 | 10.5 | grass | 0.35 | | | 0.01 | 0.002 |
| 17 | 11.0 | grass | 0.29 | | | 0.00 | 0.000 |
| 18 | 12.0 | grass | 0.22 | | | 0.00 | 0.000 |
| 19 | 13.0 | grass | 0.20 | | | 0.00 | 0.000 |
| 20 | 15.0 | grass | 0.16 | | | 0.00 | 0.000 |
| Right Bank | 18.0 | grass | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.337** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Windy Outflow

LOCATION: Outflow of Windy Lake

COORDINATES: 435222 m E, 7545888 m N (NAD83)

MEASUREMENT DATE: 12 August 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 17:05 h

MEASUREMENT END TIME: 18:10 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY 0.2 Depth (m/s) | VELOCITY 0.8 Depth (m/s) | VELOCITY 0.6 Depth (m/s) | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| Right Bank | 0.0 | | 0.22 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.28 | | | 0.00 | 0.000 |
| 3 | 1.7 | | 0.38 | | | 0.01 | 0.002 |
| 4 | 2.0 | | 0.41 | | | 0.04 | 0.005 |
| 5 | 2.3 | | 0.46 | | | 0.07 | 0.008 |
| 6 | 2.5 | | 0.48 | | | 0.13 | 0.012 |
| 7 | 2.7 | | 0.48 | | | 0.21 | 0.020 |
| 8 | 2.9 | | 0.52 | | | 0.23 | 0.024 |
| 9 | 3.1 | | 0.51 | | | 0.26 | 0.027 |
| 10 | 3.3 | | 0.52 | | | 0.28 | 0.029 |
| 11 | 3.5 | | 0.48 | | | 0.26 | 0.025 |
| 12 | 3.7 | | 0.40 | | | 0.12 | 0.010 |
| 13 | 3.9 | | 0.40 | | | 0.06 | 0.005 |
| 14 | 4.1 | | 0.32 | | | 0.02 | 0.002 |
| 15 | 4.5 | | 0.20 | | | 0.01 | 0.001 |
| 16 | 5.5 | | 0.20 | | | 0.00 | 0.000 |
| Left Bank | 12.6 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.170** |

PROJECT NAME: Hope Bay Project – Madrid Area

PROJECT NUMBER: 08-1373-0026.2000

DISCHARGE DATA

STREAM NAME: Windy Outflow

LOCATION: Outflow of Windy Lake

COORDINATES: 435222 m E, 7545888 m N (NAD83)

MEASUREMENT DATE: 9 September 2008

METER TYPE: Marsh McBirney

MEASUREMENT BY: DC / PE

COMPUTATIONS BY: DC / ZC

MEASUREMENT START TIME: 11:35 h

MEASUREMENT END TIME:12:09 h

| STATION | DISTANCE FROM RIGHT D/S BANK (m) | ICE THICKNESS (m) | DEPTH (m) | VELOCITY | | | DISCHARGE ($m^3/s$) |
|---|---|---|---|---|---|---|---|
| | | | | 0.2 Depth (m/s) | 0.8 Depth (m/s) | 0.6 Depth (m/s) | |
| Right Bank | 0.0 | | 0.00 | | | 0.00 | 0.000 |
| 2 | 1.0 | | 0.14 | | | 0.00 | 0.000 |
| 3 | 2.0 | | 0.20 | | | 0.00 | 0.000 |
| 4 | 3.0 | | 0.32 | | | 0.02 | 0.006 |
| 5 | 4.0 | | 0.32 | | | 0.02 | 0.006 |
| 6 | 5.0 | | 0.42 | | | 0.02 | 0.008 |
| 7 | 6.0 | | 0.46 | | | 0.04 | 0.014 |
| 8 | 6.5 | | 0.52 | | | 0.05 | 0.010 |
| 9 | 6.8 | | 0.48 | | | 0.15 | 0.022 |
| 10 | 7.1 | | 0.50 | | | 0.24 | 0.036 |
| 11 | 7.4 | | 0.46 | | | 0.30 | 0.041 |
| 12 | 7.7 | | 0.43 | | | 0.25 | 0.032 |
| 13 | 8.0 | | 0.46 | | | 0.14 | 0.019 |
| 14 | 8.3 | | 0.44 | | | 0.08 | 0.011 |
| 15 | 8.6 | | 0.42 | | | 0.02 | 0.003 |
| 16 | 9.0 | | 0.38 | | | 0.01 | 0.003 |
| 17 | 10.0 | | 0.20 | | | 0.01 | 0.003 |
| 18 | 12.0 | | 0.12 | | | 0.01 | 0.002 |
| Left Bank | 14.0 | | 0.00 | | | 0.00 | 0.000 |
| | | | | | | | **0.218** |

# WOLVERINE LAKE AND OUTFLOW HYDROMETRIC STATION

**H91**

**FACTSHEET**

## *LOCATION AND PURPOSE*

Located approximately 50 m upstream, on the left downstream bank of the Wolverine Lake outflow.

| Operational: | 2006<br>1/1-8/9 | 2007<br>23/5-14/9 | 2008<br>18/6-9/9 | 2009 |
|---|---|---|---|---|

Benchmark: Top of embedded boulder; 100.000 m (local) Drainage Area: 1.97 km$^2$

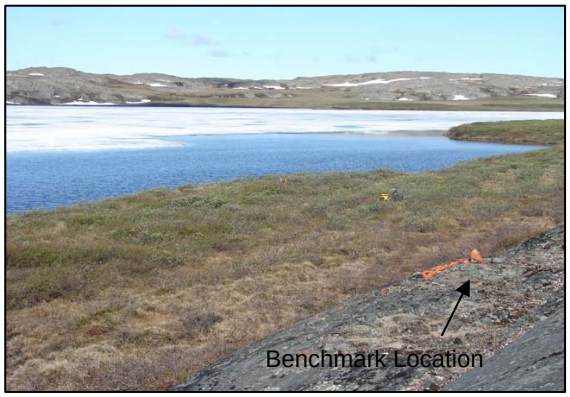
Coordinates: UTM: 435222 m E, 7545888 m N (Zone 13W NAD83) Lat/Long: 68°01'11" N, 106°33'03" W

Instruments: Optimum Instruments Datalogger, Keller Transducer

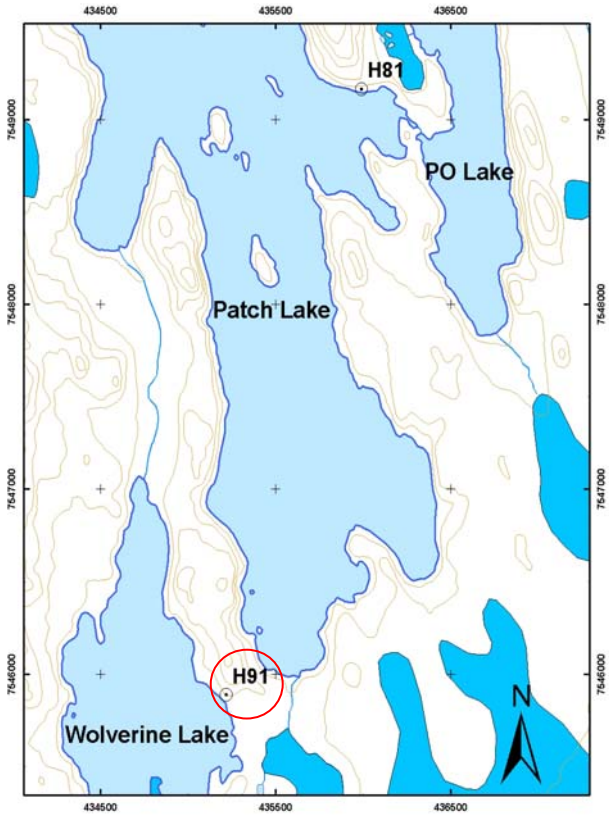
Station H91 outlet channel looking east.

Aerial view of Station H91 looking west.

Station H91 low outlet area on the southeast side.




Station H91 with benchmark looking northwest.




NTS Mapping of Area.

# Wolverine Outflow Station H91 – Stage Data (2008)

| Date and Time | Water Surface Elevation (m) | Transducer Reading (m) | Transducer Elevation (m) | Average Transducer Elevation (m) | Stage (m) |
|---|---|---|---|---|---|
| 18-Jun-2008 14:05 | | 0.876 | | 95.352 | 96.229 |
| 04-Jul-2008 20:15 | 96.177 | 0.825 | 95.352 | | 96.177 |
| 12-Aug-2008 08:20 | | 0.845 | | | 96.197 |
| 09-Sep-2008 12:35 | | 0.855 | | | 96.207 |

**H91 Wolverine Lake – 2008**

**MEAN DAILY WATER LEVELS (m) BASED ON BENCHMARK EL. 100.000 m (NON-GEODETIC)**

| DATE | JANUARY | FEBRUARY | MARCH | APRIL | MAY | JUNE | JULY | AUGUST | SEPTEMBER | OCTOBER | NOVEMBER | DECEMBER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | - | - | - | - | - | - | 96.188 | 96.213 | 96.223 | - | - | - |
| 2 | - | - | - | - | - | - | 96.185 | 96.211 | 96.229 | - | - | - |
| 3 | - | - | - | - | - | - | 96.181 | 96.207 | 96.229 | - | - | - |
| 4 | - | - | - | - | - | - | 96.178 | 96.206 | 96.227 | - | - | - |
| 5 | - | - | - | - | - | - | 96.176 | 96.206 | 96.223 | - | - | - |
| 6 | - | - | - | - | - | - | 96.175 | 96.200 | 96.219 | - | - | - |
| 7 | - | - | - | - | - | - | 96.174 | 96.195 | 96.214 | - | - | - |
| 8 | - | - | - | - | - | - | 96.173 | 96.190 | 96.211 | - | - | - |
| 9 | - | - | - | - | - | - | 96.174 | 96.189 | 96.208 P | - | - | - |
| 10 | - | - | - | - | - | - | 96.174 | 96.186 | - | - | - | - |
| 11 | - | - | - | - | - | - | 96.175 | 96.191 | - | - | - | - |
| 12 | - | - | - | - | - | - | 96.180 | 96.197 | - | - | - | - |
| 13 | - | - | - | - | - | - | 96.189 | 96.195 | - | - | - | - |
| 14 | - | - | - | - | - | - | 96.190 | 96.192 | - | - | - | - |
| 15 | - | - | - | - | - | - | 96.192 | 96.192 | - | - | - | - |
| 16 | - | - | - | - | - | - | 96.191 | 96.191 | - | - | - | - |
| 17 | - | - | - | - | - | - | 96.193 | 96.188 | - | - | - | - |
| 18 | - | - | - | - | - | 96.229 P | 96.197 | 96.183 | - | - | - | - |
| 19 | - | - | - | - | - | 96.227 | 96.200 | 96.179 | - | - | - | - |
| 20 | - | - | - | - | - | 96.226 | 96.204 | 96.176 | - | - | - | - |
| 21 | - | - | - | - | - | 96.222 | 96.205 | 96.172 | - | - | - | - |
| 22 | - | - | - | - | - | 96.217 | 96.209 | 96.171 | - | - | - | - |
| 23 | - | - | - | - | - | 96.212 | 96.209 | 96.180 | - | - | - | - |
| 24 | - | - | - | - | - | 96.207 | 96.205 | 96.179 | - | - | - | - |
| 25 | - | - | - | - | - | 96.202 | 96.209 | 96.175 | - | - | - | - |
| 26 | - | - | - | - | - | 96.198 | 96.223 | 96.172 | - | - | - | - |
| 27 | - | - | - | - | - | 96.193 | 96.222 | 96.181 | - | - | - | - |
| 28 | - | - | - | - | - | 96.190 | 96.219 | 96.184 | - | - | - | - |
| 29 | - | - | - | - | - | 96.191 | 96.217 | 96.190 | - | - | - | - |
| 30 | - | - | - | - | - | 96.189 | 96.216 | 96.201 | - | - | - | - |
| 31 | - | - | - | - | - | - | 96.216 | 96.212 | - | - | - | - |
| MIN | - | - | - | - | - | 96.189 | 96.173 | 96.171 | 96.208 | - | - | - |
| MEAN | - | - | - | - | - | 96.208 | 96.195 | 96.190 | 96.220 | - | - | - |
| MAX | - | - | - | - | - | 96.229 | 96.223 | 96.213 | 96.229 | - | - | - |

NOTES: P – PARTIAL DAILY AVERAGE

# APPENDIX A4

# HYDROLOGY DATA

# ADCP DISCHARGE MEASUREMENT SUMMARIES

This appendix contains hydrology data referenced in the body of the report. A table of contents for the appendix follows:


| Station | Description | Page |
|---|---|---|
| H83 – Aimaokatalok River | 6 July 2008 – ADCP Discharge Measurement Summary | A4-3 |
| H84 – Aimaokatalok Outflow | 6 July 2008 – ADCP Discharge Measurement Summary | A4-4 |
| | 13 August 2008 – ADCP Discharge Measurement Summary | A4-5 |
| | 11 September 2008 – ADCP Discharge Measurement Summary | A4-6 |
| H85 – Koignuk River | 6 July 2008 – ADCP Discharge Measurement Summary | A4-7 |
| | 9 August 2008 – ADCP Discharge Measurement Summary | A4-8 |
| | 14 September 2008 – ADCP Discharge Measurement Summary | A4-9 |

## H83 – Aimaokatalok River – 6 July 2008, Discharge Measurement Summary

Station Number: H83 Meas. No: 1
Station Name: Aimaokatalok River Date: 07/06/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 43.6 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 37.1 m² | Mean Velocity: 0.454 m/s |
| Gage Height: 98.282 m | G.H.Change: 0.000 m | Discharge: 16.9 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.200 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U |
| MagVar Method: None (10.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.626 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 1.33 m | Serial #: 7286 | Firmware: 10.15 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 0.853 m | Bin Size: 7 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 18.05 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 1.50 m/s | ADCP Temp.: 12.3 °C | WV : 210 | WO : 4, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: aimaokatalok-river.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 000 | R | 9.00 | 5.00 | 214 | 8.75 | 3.39 | 2.52 | 1.16 | 0.698 | 16.5 | 41.5 | 37.0 | 17:11 | 17:12 | 0.34 | 0.45 | 18 | 27 |
| *001* | *R* | *8.00* | *7.00* | *211* | *9.17* | *2.59* | *2.41* | *1.07* | *0.550* | *15.8* | *43.4* | *35.2* | *17:14* | *17:16* | *0.33* | *0.45* | *51* | *23* |
| *002* | *L* | *9.00* | *4.00* | *408* | *10.5* | *3.16* | *2.87* | *1.22* | *0.536* | *18.3* | *45.8* | *39.1* | *17:17* | *17:20* | *0.21* | *0.47* | *33* | *23* |
| **Mean** | | 8.67 | 5.33 | 277 | 9.48 | 3.04 | 2.60 | 1.15 | 0.595 | 16.9 | 43.6 | 37.1 | **Total** | 00:08 | 0.29 | 0.45 | 34 | 24 |
| **SDev** | | 0.58 | 1.53 | 113 | 0.913 | 0.410 | 0.240 | 0.078 | 0.090 | 1.28 | 2.18 | 1.92 | | | 0.08 | 0.01 | | |
| **R/M%** | | 11.5 | 56.3 | 71.1 | 18.5 | 26.2 | 17.7 | 13.5 | 27.2 | 14.8 | 10.0 | 10.3 | | | 45.63 | 4.85 | | |

## H84 – Aimaokatalok Outflow – 6 July 2008, Discharge Measurement Summary

Station Number: H84 Meas. No: 1
Station Name: Aimakatalok Lake Outflow Date: 07/06/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 26.6 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 63.3 m² | Mean Velocity: 0.759 m/s |
| Gage Height: 97.853 m | G.H.Change: 0.000 m | Discharge: 48.0 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.200 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U |
| MagVar Method: None (10.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.916 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 3.41 m | Serial #: 7286 | Firmware: 10.15 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 2.38 m | Bin Size: 24 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 58.55 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 1.50 m/s | ADCP Temp.: 5.4 °C | WV : 175 | WO : 3, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: aimaokatalok.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 000 | L | 2.00 | 2.00 | 390 | 11.8 | 27.7 | 6.34 | 0.255 | 1.45 | 47.5 | 26.6 | 62.9 | 20:36 | 20:38 | 0.17 | 0.76 | 17 | 7 |
| 001 | R | 2.00 | 2.00 | 560 | 12.0 | 29.0 | 6.46 | 0.406 | 1.44 | 49.2 | 25.8 | 63.4 | 20:39 | 20:42 | 0.12 | 0.78 | 6 | 5 |
| 002 | L | 2.00 | 2.00 | 446 | 12.2 | 28.5 | 6.61 | 0.223 | 1.12 | 48.7 | 28.6 | 66.4 | 20:43 | 20:45 | 0.15 | 0.73 | 20 | 5 |
| 003 | R | 2.00 | 2.00 | 478 | 11.7 | 27.3 | 6.29 | 0.231 | 1.16 | 46.7 | 25.4 | 60.6 | 20:46 | 20:49 | 0.14 | 0.77 | 7 | 4 |
| **Mean** | | 2.00 | 2.00 | 468 | 11.9 | 28.1 | 6.42 | 0.279 | 1.29 | 48.0 | 26.6 | 63.3 | **Total** | 00:13 | 0.14 | 0.76 | 13 | 5 |
| **SDev** | | 0.00 | 0.00 | 71 | 0.203 | 0.758 | 0.142 | 0.086 | 0.178 | 1.13 | 1.44 | 2.38 | | | 0.02 | 0.02 | | |
| **R/M%** | | 0.00 | 0.00 | 36.3 | 3.9 | 5.8 | 5.0 | 65.7 | 25.7 | 5.2 | 12.1 | 9.1 | | | 29.02 | 5.80 | | |

## H84 – Aimaokatalok Outflow – 13 August 2008, Discharge Measurement Summary

Station Number: H84 Meas. No: 2
Station Name: Aimakatalok Lake Outlet Date: 08/13/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 22.8 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 37.6 m² | Mean Velocity: 0.431 m/s |
| Gage Height: 96.653 m | G.H.Change: 0.000 m | Discharge: 16.2 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.200 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: E |
| MagVar Method: None (10.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.603 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 2.33 m | Serial #: 7286 | Firmware: 10.16 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 1.65 m | Bin Size: 10 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 47.49 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 2.00 m/s | ADCP Temp.: 12.9 °C | WV : 214 | WO : 4, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: aimaokatalok.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 000 | L | 1.00 | 2.00 | 339 | 5.71 | 7.56 | 2.13 | 0.097 | 0.559 | 16.1 | 24.2 | 39.3 | 13:55 | 13:58 | 0.15 | 0.41 | 18 | 12 |
| 001 | R | 1.00 | 2.00 | 296 | 5.80 | 7.76 | 2.08 | 0.146 | 0.557 | 16.3 | 21.8 | 36.4 | 13:58 | 14:01 | 0.13 | 0.45 | 5 | 14 |
| 002 | L | 1.00 | 2.00 | 267 | 5.73 | 7.63 | 2.12 | 0.078 | 0.554 | 16.1 | 23.0 | 38.2 | 14:02 | 14:04 | 0.15 | 0.42 | 12 | 12 |
| 003 | R | 1.00 | 2.00 | 217 | 5.71 | 7.78 | 2.09 | 0.085 | 0.543 | 16.2 | 21.9 | 36.4 | 14:04 | 14:06 | 0.18 | 0.45 | 6 | 13 |
| **Mean** | | 1.00 | 2.00 | 279 | 5.74 | 7.68 | 2.10 | 0.102 | 0.553 | 16.2 | 22.8 | 37.6 | **Total** | 00:10 | 0.15 | 0.43 | 10 | 13 |
| **SDev** | | 0.00 | 0.00 | 51 | 0.044 | 0.105 | 0.023 | 0.031 | 0.007 | 0.128 | 1.12 | 1.41 | | | 0.02 | 0.02 | | |
| **R/M%** | | 0.00 | 0.00 | 43.7 | 1.7 | 2.8 | 2.4 | 67.0 | 2.9 | 1.8 | 10.5 | 7.6 | | | 28.90 | 9.28 | | |

## H84 – Aimaokatalok Outflow – 11 September 2008, Discharge Measurement Summary

Station Number: H84 Meas. No: 3
Station Name: Aimaokatalok Lake Outlet Date: 09/11/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 24.6 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 50.8 m² | Mean Velocity: 0.605 m/s |
| Gage Height: 97.289 m | G.H.Change: 0.000 m | Discharge: 30.8 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.150 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: E |
| MagVar Method: None (12.5°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.747 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 2.92 m | Serial #: 7286 | Firmware: 10.16 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 2.07 m | Bin Size: 10 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 58.04 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 1.70 m/s | ADCP Temp.: 6.8 °C | WV : 175 | WO : 16, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: aimaokatalok.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 000 | L | 2.00 | 2.00 | 213 | 8.00 | 17.6 | 3.63 | 0.295 | 0.865 | 30.3 | 24.8 | 50.9 | 10:27 | 10:30 | 0.11 | 0.60 | 9 | 7 |
| 001 | R | 2.00 | 2.00 | 167 | 7.96 | 17.7 | 3.71 | 0.337 | 0.841 | 30.5 | 24.4 | 50.4 | 10:31 | 10:34 | 0.14 | 0.61 | 3 | 8 |
| 002 | L | 2.00 | 2.00 | 187 | 8.09 | 18.1 | 3.74 | 0.280 | 0.796 | 31.0 | 24.4 | 50.9 | 10:34 | 10:37 | 0.12 | 0.61 | 7 | 8 |
| 003 | R | 2.00 | 2.00 | 181 | 8.18 | 18.1 | 3.80 | 0.274 | 0.827 | 31.2 | 24.7 | 51.1 | 10:38 | 10:41 | 0.12 | 0.61 | 3 | 7 |
| **Mean** | | 2.00 | 2.00 | 187 | 8.06 | 17.9 | 3.72 | 0.297 | 0.832 | 30.8 | 24.6 | 50.8 | **Total** | 00:13 | 0.12 | 0.61 | 6 | 7 |
| **SDev** | | 0.00 | 0.00 | 19 | 0.101 | 0.277 | 0.072 | 0.028 | 0.029 | 0.391 | 0.22 | 0.31 | | | 0.01 | 0.01 | | |
| **R/M%** | | 0.00 | 0.00 | 24.6 | 2.8 | 3.1 | 4.6 | 21.2 | 8.3 | 2.7 | 1.8 | 1.4 | | | 23.92 | 2.31 | | |

# H85 – Koignuk River – 6 July 2008, Discharge Measurement Summary

Station Number: H85 Meas. No: 1
Station Name: Koignuk River Date: 07/06/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 97.2 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 190.5 m² | Mean Velocity: 0.531 m/s |
| Gage Height: 0.000 m | G.H.Change: 0.000 m | Discharge: 98.7 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.250 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U |
| MagVar Method: None (10.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.983 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 3.61 m | Serial #: 7286 | Firmware: 10.15 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 1.97 m | Bin Size: 25 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 41.93 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 1.50 m/s | ADCP Temp.: 9.2 °C | WV : 175 | WO : 3, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: koignuk-river.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 000 | L | 3.00 | 2.00 | 371 | 42.6 | 39.7 | 17.5 | 0.080 | -0.114 | 99.9 | 111.0 | 213.4 | 12:01 | 12:03 | 0.71 | 0.47 | 23 | 1 |
| 004 | L | 5.00 | 6.00 | 384 | 41.2 | 40.2 | 16.9 | -0.093 | -0.062 | 98.1 | 107.2 | 208.7 | 12:11 | 12:13 | 0.65 | 0.47 | 7 | 2 |
| 006 | L | 4.00 | 7.00 | 542 | 41.3 | 38.7 | 17.9 | 0.068 | 0.353 | 98.4 | 101.2 | 197.1 | 12:17 | 12:20 | 0.48 | 0.50 | 2 | 3 |
| 009 | L | 5.00 | 4.00 | 718 | 33.2 | 46.9 | 15.7 | 1.48 | 1.12 | 98.4 | 69.4 | 143.1 | 12:28 | 12:33 | 0.24 | 0.69 | 19 | 2 |
| **Mean** | | 4.25 | 4.75 | 503 | 39.6 | 41.4 | 17.0 | 0.384 | 0.323 | 98.7 | 97.2 | 190.5 | **Total** | 00:32 | 0.52 | 0.53 | 13 | 2 |
| **SDev** | | 0.96 | 2.22 | 163 | 4.30 | 3.71 | 0.981 | 0.735 | 0.568 | 0.791 | 18.96 | 32.39 | | | 0.21 | 0.11 | | |
| **R/M%** | | 47.1 | 105 | 69.0 | 23.8 | 19.6 | 13.2 | 409.9 | 380.5 | 1.8 | 42.8 | 36.9 | | | 90.99 | 41.41 | | |

## H85 – Koignuk River – 9 August 2008, Discharge Measurement Summary

Station Number: H85 Meas. No: 2
Station Name: Koignuk River Date: 08/09/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 56.1 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 91.3 m² | Mean Velocity: 0.319 m/s |
| Gage Height: 97.351 m | G.H.Change: 0.000 m | Discharge: 29.1 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.250 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U |
| MagVar Method: None (10.0°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.495 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 3.12 m | Serial #: 7286 | Firmware: 10.16 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 1.63 m | Bin Size: 10 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 47.94 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 2.00 m/s | ADCP Temp.: 12.7 °C | WV : 214 | WO : 4, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: Koignuk9Aug.mmt
Software: 2.02

| Tr.# | | Edge Distance L | Edge Distance R | #Ens. | Discharge Top | Discharge Middle | Discharge Bottom | Discharge Left | Discharge Right | Discharge Total | Total | Area | Time Start | Time End | Mean Vel. Boat | Mean Vel. Water | % Bad End | % Bad Bins |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 000 | R | 7.00 | 3.00 | 172 | 11.0 | 14.0 | 3.47 | 0.615 | 0.512 | 29.6 | 57.2 | 94.2 | 10:56 | 10:57 | 0.64 | 0.31 | 17 | 20 |
| 001 | L | 5.00 | 2.00 | 165 | 9.80 | 14.7 | 3.77 | 0.401 | 0.369 | 29.0 | 52.5 | 91.6 | 10:57 | 10:58 | 0.68 | 0.32 | 14 | 17 |
| 002 | R | 7.00 | 2.00 | 182 | 10.8 | 13.8 | 3.54 | 0.437 | 0.402 | 28.9 | 53.4 | 85.6 | 10:59 | 11:00 | 0.58 | 0.34 | 14 | 19 |
| 004 | R | 9.00 | 4.00 | 170 | 10.3 | 13.3 | 3.35 | 0.964 | 0.680 | 28.7 | 58.2 | 91.3 | 11:02 | 11:04 | 0.65 | 0.31 | 21 | 20 |
| 005 | L | 5.00 | 4.00 | 201 | 10.2 | 14.0 | 3.57 | 0.404 | 0.647 | 28.8 | 54.2 | 89.9 | 11:04 | 11:06 | 0.56 | 0.32 | 17 | 20 |
| 006 | R | 9.00 | 3.00 | 239 | 10.4 | 14.0 | 3.42 | 0.973 | 0.659 | 29.4 | 57.8 | 92.7 | 11:06 | 11:08 | 0.44 | 0.32 | 13 | 25 |
| 007 | L | 9.00 | 5.00 | 190 | 10.0 | 14.0 | 3.57 | 0.750 | 1.17 | 29.5 | 59.6 | 93.9 | 11:08 | 11:09 | 0.56 | 0.32 | 10 | 18 |
| **Mean** | | 7.29 | 3.29 | 188 | 10.4 | 14.0 | 3.53 | 0.649 | 0.634 | 29.1 | 56.1 | 91.3 | **Total** | 00:13 | 0.59 | 0.32 | 15 | 20 |
| **SDev** | | 1.80 | 1.11 | 26 | 0.411 | 0.386 | 0.132 | 0.252 | 0.266 | 0.364 | 2.72 | 2.90 | | | 0.08 | 0.01 | | |
| **R/M%** | | 54.9 | 91.3 | 39.4 | 11.6 | 9.4 | 11.7 | 88.1 | 125.8 | 3.1 | 12.6 | 9.3 | | | 40.50 | 7.52 | | |

## H85 – Koignuk River – 14 September 2008, Discharge Measurement Summary

Station Number: H85 Meas. No: 3
Station Name: Koignuk River Date: 09/14/2008

| | | |
|---|---|---|
| Party: Golder Crew | Width: 64.0 m | Processed by: Dan Ciobotaru |
| Boat/Motor: Inflatable Boat, Zodiac | Area: 111.6 m² | Mean Velocity: 0.483 m/s |
| Gage Height: 97.802 m | G.H.Change: 0.000 m | Discharge: 53.9 m³/s |

| | | | |
|---|---|---|---|
| Area Method: Avg. Course | ADCP Depth: 0.150 m | Index Vel.: 0.00 m/s | Rating No.: 1 |
| Nav. Method: Bottom Track | Shore Ens.:10 | Adj.Mean Vel: 0.00 m/s | Qm Rating: U |
| MagVar Method: None (12.5°) | Bottom Est: Power (0.1667) | Rated Area: 0.000 m² | Diff.: 0.000% |
| Depth Sounder: Not Used | Top Est: Power (0.1667) | Control1: Unspecified | |
| | | Control2: Unspecified | |
| | | Control3: Unspecified | |

| Screening Thresholds: | | ADCP: | |
|---|---|---|---|
| BT 3-Beam Solution: YES | Max. Vel.: 0.759 m/s | Type/Freq.: Rio Grande/0 kHz | |
| WT 3-Beam Solution: NO | Max. Depth: 3.29 m | Serial #: 7286 | Firmware: 10.16 |
| BT Error Vel.: 0.10 m/s | Mean Depth: 1.75 m | Bin Size: 15 cm | Blank: 25 cm |
| WT Error Vel.: 1.07 m/s | % Meas.: 50.36 | BT Mode: 5 | BT Pings: 1 |
| BT Up Vel.: 0.30 m/s | Water Temp.: None | WT Mode: 12 | BT Pings: 1 |
| WT Up Vel.: 2.50 m/s | ADCP Temp.: 3.5 °C | WV : 175 | WO : 3, 4 |
| Use Weighted Mean Depth: YES | | | |

Performed Diag. Test: NO
Performed Moving Bed Test: NO
Performed Compass Test: NO
Meas. Location:

Project Name: koignuk14septA.mmt
Software: 2.02

| Tr.# | | Edge Distance | | #Ens. | Discharge | | | | | | Total | Area | Time | | Mean Vel. | | % Bad | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | L | R | | Top | Middle | Bottom | Left | Right | Total | | | Start | End | Boat | Water | End | Bins |
| 001 | R | 4.00 | 5.00 | 422 | 16.1 | 28.6 | 7.66 | 0.642 | 0.989 | 54.1 | 56.0 | 106.6 | 09:49 | 09:52 | 0.35 | 0.51 | 1 | 12 |
| 002 | L | 3.00 | 5.00 | 640 | 18.3 | 25.9 | 8.41 | 0.234 | 0.712 | 53.6 | 68.1 | 114.3 | 09:55 | 10:00 | 0.27 | 0.47 | 13 | 14 |
| 004 | L | 3.00 | 5.00 | 422 | 18.0 | 27.0 | 8.02 | 0.419 | 0.814 | 54.2 | 64.5 | 111.6 | 10:06 | 10:09 | 0.35 | 0.49 | 4 | 14 |
| 006 | L | 4.00 | 6.00 | 475 | 17.6 | 26.9 | 7.75 | 0.503 | 0.880 | 53.6 | 67.2 | 113.8 | 10:13 | 10:17 | 0.32 | 0.47 | 2 | 15 |
| **Mean** | | 3.50 | 5.25 | 489 | 17.5 | 27.1 | 7.96 | 0.450 | 0.849 | 53.9 | 64.0 | 111.6 | **Total** | 00:27 | 0.32 | 0.48 | 5 | 14 |
| **SDev** | | 0.58 | 0.50 | 103 | 0.953 | 1.12 | 0.337 | 0.171 | 0.116 | 0.325 | 5.53 | 3.53 | | | 0.04 | 0.02 | | |
| **R/M%** | | 28.6 | 19.0 | 44.6 | 12.4 | 10.0 | 9.4 | 90.8 | 32.6 | 1.2 | 19.0 | 6.9 | | | 26.25 | 7.86 | | |

# APPENDIX B1

# WATER QUALITY GUIDELINES, TROPHIC CLASSIFICATION, AND PHYSICO-CHEMICAL CLASSIFICATION

# B1.0 WATER QUALITY GUIDELINES, TROPHIC CLASSIFICATIONS, AND PHYSICO-CHEMICAL CLASSIFICATIONS

The following descriptions are provided to give a brief explanation of the water quality guidelines used and the toxicity modifying factors (i.e., pH, temperature, hardness), when applicable, as well as the trophic status and physico-chemical classifications for lakes.

## B1.1 WATER QUALITY GUIDELINES

### B1.1.1 Aluminum

The freshwater CWQG for aluminum is dependent on the pH of the waterbody as follows (CCME 1999, 2007a):

- 5.0 micrograms per litre (µg/L) for waters with pH < 6.5; and
- 100 µg/L for waters with pH ≥ 6.5.

### B1.1.2 Ammonia

The freshwater CWQGs for ammonia are dependent on water temperature and pH (Table B1-1). Ammonia is highly soluble in water, and these two environmental parameters affect whether it is present in an un-ionized ($NH_3$) or ionized ($NH_4^+$) form (CCME 1999, 2007a). The speciation of ammonia is important, as the un-ionized form is more toxic to aquatic life than the ionized form due to its ability to diffuse across biological membranes more easily (CCME 1999). An increase of one pH unit can cause un-ionized ammonia concentrations to increase nearly ten-fold; a 5°C temperature increase can cause a 40 to 50% increase in un-ionized ammonia (CCME 1999). The term 'total ammonia' is the sum of $NH_3$ and $NH_4^+$. CWQGs for total ammonia were as follows:

**Table B1-1 Canadian Water Quality Guidelines for Total Ammonia**

| pH | Water Temperature (°C) | CWQG – Ammonia (mg N/L) | CWQG Application |
|---|---|---|---|
| 6.0 | 5 | 122.4 | temperature 3 to 7°C; pH 5.3 to 6.2 |
| | 10 | 81.6 | temperature 8 to 12°C; pH 5.3 to 6.2 |
| | 15 | 55.8 | temperature 13 to 17°C; pH 5.3 to 6.2 |
| 6.5 | 5 | 38.6 | temperature 3 to 7°C; pH 6.3 to 6.7 |
| | 10 | 25.9 | temperature 8 to 12°C; pH 6.3 to 6.7 |
| | 15 | 17.6 | temperature 13 to 17°C; pH 6.3 to 6.7 |
| 7.0 | 5 | 12.4 | temperature 3 to 7°C; pH 6.8 to 7.2 |
| | 10 | 8.2 | temperature 8 to 12°C; pH 6.8 to 7.2 |
| | 15 | 5.6 | temperature 13 to 17°C; pH 6.8 to 7.2 |
| 7.5 | 5 | 3.9 | temperature 3 to 7°C; pH 7.3 to 7.7 |
| | 10 | 2.6 | temperature 8 to 12°C; pH 7.3 to 7.7 |
| | 15 | 1.8 | temperature 13 to 17°C; pH 7.3 to 7.7 |
| 8.0 | 5 | 1.2 | temperature 3 to 7°C; pH 7.8 to 8.2 |
| | 10 | 0.8 | temperature 8 to 12°C; pH 7.8 to 8.2 |
| | 15 | 0.6 | temperature 13 to 17°C; pH 7.8 to 8.2 |
| 8.5 | 5 | 0.4 | temperature 3 to 7°C; pH 8.3 to 8.7 |
| | 10 | 0.3 | temperature 8 to 12°C; pH 8.3 to 8.7 |
| | 15 | 0.2 | temperature 13 to 17°C; pH 8.3 to 8.7 |

Notes: CWQG = Canadian Water Quality Guideline; °C = degrees Celsius; mg/L = milligrams per litre.
Source: CCME 1999.

### B1.1.3 Cadmium

The freshwater CWQG for cadmium is dependent on water hardness. Site specific guidelines can be calculated by the following formula:

$$\text{CWQG cadmium} = 10^{\{0.86[\log(\text{hardness})]-3.2\}}$$

where the CWQG is measured in µg/L and hardness is measured as calcium carbonate ($CaCO_3$) equivalents in mg/L (CCME 1999, 2007a) (Table B1-2).

**Table B1-2 Hardness-Adjusted Total Cadmium Guidelines**

| Total Hardness (mg $CaCO_3$/L) | CWQG Total Cadmium (µg/L) | Total Hardness (mg $CaCO_3$/L) | CWQG Total Cadmium (µg/L) |
|---|---|---|---|
| 5.0 to 7.3 | 0.003 | 87.5 to 90.8 | 0.030 |
| 7.4 to 9.8 | 0.004 | 90.9 to 94.3 | 0.031 |
| 9.9 to 12.4 | 0.005 | 94.4 to 97.8 | 0.032 |
| 12.5 to 15.0 | 0.006 | 97.9 to 101.3 | 0.033 |
| 15.1 to 17.7 | 0.007 | 101.4 to 104.8 | 0.034 |
| 17.8 to 20.5 | 0.008 | 104.9 to 108.4 | 0.035 |
| 20.6 to 23.4 | 0.009 | 109.3 to 111.9 | 0.036 |
| 23.5 to 26.3 | 0.010 | 112.0 to 115.5 | 0.037 |
| 26.4 to 29.2 | 0.011 | 115.6 to 119.1 | 0.038 |
| 29.3 to 32.2 | 0.012 | 119.2 to 122.7 | 0.039 |
| 32.3 to 35.2 | 0.013 | 122.8 to 126.3 | 0.040 |
| 35.3 to 38.2 | 0.014 | 126.4 to 130.0 | 0.041 |
| 38.3 to 41.3 | 0.015 | 131.1 to 133.6 | 0.042 |
| 41.4 to 44.4 | 0.016 | 133.7 to 137.3 | 0.043 |
| 44.5 to 47.6 | 0.017 | 137.4 to 141.0 | 0.044 |
| 47.7 to 50.8 | 0.018 | 141.1 to 144.7 | 0.045 |
| 50.9 to 54.0 | 0.019 | 144.8 to 148.4 | 0.046 |
| 54.1 to 57.2 | 0.020 | 148.5 to 152.1 | 0.047 |
| 57.3 to 60.5 | 0.021 | 152.2 to 155.8 | 0.048 |
| 60.6 to 63.8 | 0.022 | 155.9 to 159.5 | 0.049 |
| 63.9 to 67.1 | 0.023 | 159.6 to 163.3 | 0.050 |
| 67.2 to 70.4 | 0.024 | 163.4 to 167.1 | 0.051 |
| 70.5 to 73.8 | 0.025 | 167.2 to 170.9 | 0.052 |
| 73.9 to 77.1 | 0.026 | 171.0 to 174.6 | 0.053 |
| 77.2 to 80.5 | 0.027 | 175.0 to 178.4 | 0.054 |
| 80.6 to 83.9 | 0.028 | 178.5 to 182.3 | 0.055 |
| 84.0 to 87.4 | 0.029 | 182.4 to 186.1 | 0.056 |

Notes: $CaCO_3$ = Calcium Carbonate; CWQG = Canadian Water Quality Guideline; mg/L = milligrams per litre; µg/L = micrograms per litre

The marine CWQG for total cadmium is 0.12 µg/L (CCME 2007a). Site specific guidelines are not calculated for marine systems.

The CDWG for total cadmium in treated drinking water is 5 µg/L (Health Canada 2008).

### B1.1.4 Chromium

The CWQGs for chromium are based on oxidation states, with trivalent (Cr[III]) being the most stable and hexavalent (Cr[VI]) being strongly oxidizing (CCME 1999). Cr(VI) is very soluble and mobile, with potentially long residence times in surface water and aerobic soils. Cr(VI) is generally more toxic than Cr(III) because of its high oxidizing potential, high solubility, and ease at which it can permeate biological membranes. In addition, up to 60% of chromium in surface waters can exist in the Cr(VI) state. Cr(III) is less toxic in comparison to Cr(VI) because it forms highly insoluble compounds that have a tendency to adsorb to surfaces (CCME 1999).

In addition, total chromium includes particulate chromium because the samples are not filtered. This can be problematic, particularly in spring when erosion and turbidity are high, as chromium measurements may exceed guidelines, but biota do not suffer any adverse effects (CCME 1999).

The following guidelines were used for assessing total chromium concentrations:

- 1.0 µg/L for sublethal toxicity effects (CCME 2007a); and
- 16 µg/L for acute toxicity effects (USEPA 2008).

The CDWG for total chromium in treated drinking water is 50 µg/L (Health Canada 2008).

### B1.1.5 Copper

The CWQGs for copper are dependent on water hardness (measured as $CaCO_3$) as follows (Table B1-3) (CCME 1999, 2007a):

**Table B1-3 Canadian Water Quality Guidelines for Copper**

| Water Hardness (mg $CaCO_3$/L) | CWQG – Copper (µg/L) |
|---|---|
| <120 | 2 |
| 120 to 180 | 3 |
| >180 | 4 |

Notes: CWQG = Canadian Water Quality Guideline; $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; µg/L = micrograms per litre. Source: CCME 1999.

The CDWG aesthetic objective for copper in treated drinking water is < 1000 µg/L (Health Canada 2008).

### B1.1.6 Lead

The CWQGs for lead are dependent on water hardness (measured as $CaCO_3$) as follows (Table B1-4) (CCME 1999, 2007a):

**Table B1-4 Canadian Water Quality Guidelines for Lead**

| Water Hardness (mg $CaCO_3$/L) | CWQG – Lead (µg/L) |
|---|---|
| 0 to 60 | 1 |
| 60 to 120 | 2 |
| 120 to 180 | 4 |
| >180 | 7 |

Notes: CWQG = Canadian Water Quality Guideline; $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; µg/L = micrograms per litre. Source: CCME 1999.

The CDWG for lead in treated drinking water is 10 µg/L (Health Canada 2008).

### B1.1.7 Nickel

The CWQGs for nickel are dependant on water hardness (measured as $CaCO_3$) as follows (Table B1-5) (CCME 1999, 2007a):

**Table B1-5 Canadian Water Quality Guidelines for Nickel**

| Water Hardness (mg $CaCO_3$/L) | CWQG – Nickel (µg/L) |
|---|---|
| 0 to 60 | 25 |
| 60 to 120 | 65 |
| 120 to 180 | 110 |
| >180 | 150 |

Notes: CWQG = Canadian Water Quality Guideline; $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; µg/L = micrograms per litre. Source: CCME 1999.

### B1.1.8 Zinc

Both sublethal and acute guidelines for zinc were compared to existing concentrations in waterbodies within the Project area. For sublethal toxicity, the CWQG of 30 µg/L (CCME 2007a) was used. While this guideline is conservative, it does not take into account water hardness. Therefore, the USEPA (2008) guideline, which is adjusted for water hardness, was included for acute

toxicity. Zinc concentrations were adjusted for water hardness based on the following equation:

$$\text{WQG total zinc} = \exp\{0.8473*[\ln(\text{hardness})]+0.884\}$$

Acute toxicity values for ranges of water hardness found in the waterbodies within the Project Area are summarized in (Table B1-6).

The CDWG aesthetic objective for zinc in treated drinking water is < 5000 µg/L (Health Canada 2008).

## Table B1-6 Hardness-Adjusted Total Zinc Acute Toxicity Guidelines

| Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|
| 7.0 to 7.5 | 13 | 43.8 to 44.5 | 60 | 87.0 to 88.0 | 107 | 134.0 to 134.9 | 154 |
| 7.6 to 8.2 | 14 | 44.6 to 45.4 | 61 | 88.1 to 88.9 | 108 | 135.0 to 135.9 | 155 |
| 8.3 to 8.9 | 15 | 45.5 to 46.3 | 62 | 88.9 to 89.8 | 109 | 136.0 to 137.0 | 156 |
| 9.0 to 9.5 | 16 | 46.4 to 47.2 | 63 | 89.9 to 90.8 | 110 | 137.1 to 138.0 | 157 |
| 9.6 to 10.2 | 17 | 47.3 to 48.1 | 64 | 90.9 to 91.8 | 111 | 138.1 to 139.0 | 158 |
| 10.3 to 10.9 | 18 | 48.2 to 48.9 | 65 | 91.9 to 92.7 | 112 | 139.1 to 140.1 | 159 |
| 11.0 to 11.6 | 19 | 49.0 to 49.8 | 66 | 92.8 to 93.7 | 113 | 140.2 to 141.1 | 160 |
| 11.7 to 12.4 | 20 | 49.9 to 50.7 | 67 | 93.8 to 94.7 | 114 | 141.2 to 142.1 | 161 |
| 12.5 to 13.1 | 21 | 50.8 to 51.6 | 68 | 94.8 to 95.7 | 115 | 142.2 to 143.2 | 162 |
| 13.2 to 13.8 | 22 | 51.7 to 52.5 | 69 | 95.8 to 96.6 | 116 | 143.3 to 144.2 | 163 |
| 13.9 to 14.5 | 23 | 52.6 to 53.4 | 70 | 96.7 to 97.6 | 117 | 144.3 to 145.3 | 164 |
| 14.6 to 15.3 | 24 | 53.5 to 54.3 | 71 | 97.7 to 98.6 | 118 | 145.4 to 146.4 | 165 |
| 15.4 to 16.0 | 25 | 54.4 to 55.2 | 72 | 98.7 to 99.6 | 119 | 146.4 to 147.3 | 166 |
| 16.1 to 16.8 | 26 | 55.3 to 56.1 | 73 | 99.7 to 100.6 | 120 | 147.4 to 148.4 | 167 |
| 16.9 to 17.5 | 27 | 56.2 to 57.0 | 74 | 100.7 to 101.6 | 121 | 148.5 to 149.4 | 168 |
| 17.6 to 18.3 | 28 | 57.1 to 57.9 | 75 | 101.7 to 102.5 | 122 | 149.5 to 150.5 | 169 |
| 18.4 to 19.0 | 29 | 58.0 to 58.8 | 76 | 102.6 to 103.5 | 123 | 150.6 to 151.5 | 170 |
| 19.1 to 19.8 | 30 | 58.9 to 59.7 | 77 | 103.6 to 104.5 | 124 | 151.6 to 152.6 | 171 |
| 19.9 to 20.6 | 31 | 59.8 to 60.6 | 78 | 104.6 to 105.5 | 125 | 152.7 to 153.6 | 172 |
| 20.7 to 21.4 | 32 | 60.7 to 61.5 | 79 | 105.6 to 106.5 | 126 | 153.7 to 154.7 | 173 |
| 21.5 to 22.1 | 33 | 61.6 to 62.4 | 80 | 106.6 to 107.5 | 127 | 154.8 to 155.7 | 174 |
| 22.2 to 22.9 | 34 | 62.5 to 63.4 | 81 | 107.6 to 108.5 | 128 | 155.8 to 156.8 | 175 |
| 23.0 to 23.7 | 35 | 63.5 to 64.3 | 82 | 108.6 to 109.5 | 129 | 156.9 to 157.9 | 176 |
| 23.8 to 24.5 | 36 | 64.4 to 65.2 | 83 | 109.6 to 110.5 | 130 | 158.0 to 158.9 | 177 |
| 24.6 to 25.3 | 37 | 65.3 to 66.1 | 84 | 110.6 to 111.5 | 131 | 159.0 to 160.0 | 178 |
| 25.4 to 26.1 | 38 | 66.2 to 67.1 | 85 | 111.6 to 112.5 | 132 | 160.1 to 161.0 | 179 |
| 26.2 to 26.9 | 39 | 67.2 to 68.0 | 86 | 112.6 to 113.5 | 133 | 161.1 to 162.1 | 180 |
| 27.0 to 27.7 | 40 | 68.1 to 68.9 | 87 | 113.6 to 114.5 | 134 | 162.2 to 163.2 | 181 |
| 27.8 to 28.5 | 41 | 69.0 to 69.8 | 88 | 114.6 to 115.5 | 135 | 163.3 to 164.2 | 182 |
| 28.6 to 29.3 | 42 | 69.9 to 70.8 | 89 | 115.6 to 116.5 | 136 | 164.3 to 165.3 | 183 |
| 29.4 to 30.2 | 43 | 70.9 to 71.7 | 90 | 116.6 to 117.5 | 137 | 165.4 to 166.3 | 184 |
| 30.3 to 31.0 | 44 | 71.8 to 72.6 | 91 | 117.6 to 118.6 | 138 | 166.4 to 167.4 | 185 |
| 31.1 to 31.8 | 45 | 72.7 to 73.6 | 92 | 119.7 to 119.6 | 139 | 167.5 to 168.5 | 186 |
| 31.9 to 32.6 | 46 | 73.7 to 74.5 | 93 | 119.7 to 120.6 | 140 | 168.6 to 169.5 | 187 |
| 32.7 to 33.5 | 47 | 74.6 to 75.4 | 94 | 120.7 to 121.6 | 141 | 169.6 to 170.6 | 188 |
| 33.6 to 34.3 | 48 | 75.5 to 76.4 | 95 | 121.7 to 122.6 | 142 | 170.7 to 171.7 | 189 |
| 34.4 to 35.1 | 49 | 76.5 to 77.4 | 96 | 122.7 to 123.6 | 143 | 171.8 to 172.7 | 190 |
| 35.2 to 36.0 | 50 | 77.5 to 78.3 | 97 | 123.7 to 124.6 | 144 | 172.8 to 173.8 | 191 |
| 36.1 to 36.8 | 51 | 78.4 to 79.3 | 98 | 124.7 to 125.7 | 145 | 173.9 to 174.9 | 192 |
| 36.9 to 37.7 | 52 | 79.4 to 80.2 | 99 | 125.8 to 126.7 | 146 | 175.0 to 176.0 | 193 |
| 37.8 to 38.5 | 53 | 80.3 to 81.2 | 100 | 126.8 to 127.7 | 147 | 176.1 to 177.0 | 194 |
| 38.6 to 39.4 | 54 | 81.3 to 82.1 | 101 | 127.8 to 128.7 | 148 | 177.1 to 178.1 | 195 |

**Table B1-6 Hardness-Adjusted Total Zinc Acute Toxicity Guidelines (continued)**

| Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) | Total Hardness (mg $CaCO_3$/L) | WQG - Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| 39.5 to 40.2 | 55 | 82.2 to 83.1 | 102 | 128.8 to 129.9 | 149 | 178.2 to 179.2 | 196 |
| 40.3 to 41.1 | 56 | 83.2 to 84.0 | 103 | 129.9 to 130.8 | 150 | 179.3 to 180.3 | 197 |
| 41.2 to 41.9 | 57 | 84.1 to 85.0 | 104 | 130.9 to 131.8 | 151 | 180.4 to 181.3 | 198 |
| 42.0 to 42.8 | 58 | 85.1 to 86.0 | 105 | 131.9 to 132.8 | 152 | 181.4 to 182.4 | 199 |
| 42.9 to 43.7 | 59 | 86.1 to 86.9 | 106 | 132.9 to 133.9 | 153 | 182.5 to 183.5 | 200 |

## B1.2 TROPHIC STATUS CLASSIFICATION

Nutrient concentrations (i.e., phosphorus, nitrogen) and productivity (e.g., Chl *a*) can be used to classify lakes into trophic categories. Classifying lakes based on trophic status is useful for assessing potential effects resulting from nutrient loading.

At present, there are no CWQGs for total phosphorus. There are also no CWQGs for total phosphorus toxicity. CCME suggests the following series of Trigger Ranges for the prevention of eutrophication (Table B1-7), but not toxicity (CCME 2004):

**Table B1-7 Canadian Council of Ministers for the Environment Trigger Ranges for Phosphorus**

| Productivity | Total Phosphorus Trigger Ranges (µg/L) |
|---|---|
| ultra-oligotrophic | <4 |
| oligotrophic | 4 to 10 |
| mesotrophic | 10 to 20 |
| meso-eutrophic | 20 to 35 |
| eutrophic | 35 to 100 |
| hyper-eutrophic | >100 |

Notes: µg/L = micrograms per litre. Source: CCME 2004

There are no guidelines for Chl *a* because this is a measure of algal productivity within the water column and is not related to toxicity. The Organisation for Economic Co-operation and Development (OECD) developed a classification system based on a worldwide study of lake fertility (Mitchell and Prepas 1990).

The OECD trophic classification system is based on the following maximum Chl *a* concentrations (Table B1-8):

**Table B1-8 OECD Productivity Classification System based on Maximum Chlorophyll *a* Concentrations**

| Productivity | Chlorophyll *a* (µg/L) |
|---|---|
| oligotrophic | <8 |
| oligo-mesotrophic | occasionally over 8 |
| mesotrophic | 8 to 25 |
| eutrophic | 26 to 75 |
| hyper-eutrophic | >75 |

Notes: µg/L = micrograms per litre. Source: Mitchell and Prepas 1990.

In marine systems, nitrogen is often the limiting nutrient rather than phosphorus, which is typically the limiting nutrient in freshwater systems (CCME 2007b). Phosphorus may be limiting in marine environments during periods of high freshwater flows, but these effects are temporary (CCME 2007b).

A similar approach to classifying marine trophic status is based on the Trophic Index for Marine Systems (TRIX) (CCME 2007b). While there are other marine classification systems (e.g., National Oceanographic and Atmospheric Administration Index, OSPAR Comprehensive Procedure Index), the TRIX has been applied to the Project because of its similarity to the freshwater classification system. TRIX is based on the following criteria (Table B1-9):

**Table B1-9 Trophic Index for Marine Systems based on Total Nitrogen, Total Phosphorus, Chlorophyll *a,* and Secchi Depth**

| Trophic Status | Total Nitrogen ($mg/m^3$) | Total Phosphorus ($mg/m^3$) | Chlorophyll *a* (µg/L) | Secchi Depth (m) |
|---|---|---|---|---|
| Oligotrophic | <260 | <10 | <1 | >6 |
| Mesotrophic | ≥260 to 350 | ≥10 to 30 | ≥1 to 3 | 3 to ≤6 |
| Eutrophic | ≥350 to 400 | ≥30 to 40 | ≥3 to 5 | 1.5 to ≤3 |
| Hyper-eutrophic | >400 | >40 | >5 | <1.5 |

µg/L = micrograms per litre; m = metre; > = greater than; ≥ = greater than or equal to; < = less than; ≤ = less than or equal to. Source: CCME 2007b)

## B1.3 PHYSICO-CHEMICAL CLASSIFICATION

### B1.3.1 Salinity

The analysis of total dissolved solids (TDS) is used to provide a measure of the total major ion content of water, which is indicative of salinity. Salinity was assessed on the following scale (Table B1-10) (Mitchell and Prepas 1990):

**Table B1-10 Salinity Classification Based Total Dissolved Solids Concentration**

| Salinity Classification | Total Dissolved Solids (mg/L) |
|---|---|
| fresh | <500 |
| slightly saline | 500 to 1000 |
| moderately saline | 1000 to 5000 |
| saline | >5000 |

Notes: mg/L = milligrams per litre; < = less than; > = greater than. Source: Mitchell and Prepas 1990.

### B1.3.2 Water Hardness

Water hardness is primary caused by the presence of calcium and magnesium salts in water, although other polyvalent ions can contribute to total hardness. Water hardness was assessed on the following scale (Table B1-11) (Weiner 2000):

**Table B1-11 Calcium Carbonate Water Hardness Classification**

| Water Hardness Classification | Calcium Carbonate (mg $CaCO_3$/L) |
|---|---|
| soft | <75 |
| moderately hard | 75 to 120 |
| hard | 120 to 200 |
| very hard | >200 |

Notes: $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; < = less than; > = greater than.
Source: Weiner 2000.

### B1.3.3 Acid Neutralizing Capacity

Total alkalinity is a common measure of the acid neutralizing capacity of water. As such, it can be used to provide an indication of the sensitivity of a waterbody to acid deposition. According to Saffran and Trew (1996), acid sensitivity ranges

of lakes are based on total alkalinity measured as $CaCO_3$; however, these sensitivity ranges are based solely on lentic data (standing waters) and there is no information for lotic (flowing) waters. Acid sensitivity ranges of lakes are defined as follows (Table B1-12):

**Table B1-12 Acid Neutralizing Capacity based on Calcium Carbonate Alkalinity**

| Acid Neutralizing Capacity | Alkalinity (mg $CaCO_3$/L) |
|---|---|
| high acid sensitivity | <10 |
| moderate acid sensitivity | 11 to 20 |
| low acid sensitivity | 21 to 40 |
| negligible acid sensitivity | >40 |

Notes: $CaCO_3$ = calcium carbonate; mg/L = milligrams per litre; < = less than; > = greater than.
Source: Saffran and Trew 1996.

# APPENDIX B2
# QUALITY ASSURANCE / QUALITY CONTROL

# Appendix B2 QUALITY ASSURANCE/QUALITY CONTROL

Quality assurance/quality control (QA/QC) procedures and requirements are an important aspect of any field or laboratory testing program. The objective of good QA/QC practices is having appropriate methodology in place so that field sampling, data entry, data analysis, and report preparation produce technically sound and scientifically defensible results.

## B2.1 QA/QC METHODS

Detailed specific work instructions (SWIs) outlining each field task were provided to the field personnel prior to the field program. Samples were collected by experienced personnel and were labelled, preserved, and shipped according to Golder's Technical Procedures 8.23-0: *Basic Limnology and Bathymetric Procedures* and 8.3-1: *Surface Water Sampling Methods* (unpublished file information). Additionally, the calibration and routine testing of all field equipment (*i.e.*, water meter) was regularly conducted according to the manufacturer's recommendations.

In addition, detailed field notes were recorded in pencil in waterproof field notebooks. Field data were checked at the end of each day for completeness and accuracy. Chain-of-Custody (COC) forms were used to track all sample shipments from the field to the applicable analytical laboratory.

Blank and duplicate samples were included as part of the water quality QA/QC for lakes and rivers (Table 3.9 in report text). One laboratory split sample was tested for one marine site, Hope Bay, sample on 19 Aug 2008.

Field blanks and equipment blanks were used to determine if sample contamination might have occurred during water sample collection, sample handling, or laboratory analytical procedures. Field blanks are a set of separate sample bottles filled in the field with a sample of deionized water, which are then shipped to the laboratiory with the field samples. Equipment blanks are also separate sample bottles filled in the field with deionized water that has been poured through decontaminated field equipment, such as the Kemmerer water sampler, prior to the collection of field samples.

A duplicate water sample (duplicate) is a second water sample collected at a sampling station using the same methods as the first field sample. Duplicates are collected to assess variability introduced during sample collection, sample

handling, and laboratory analytical procedures. Duplicates were taken at the top of the water column on each of the Stickleback Lake, Doris Lake, and Windy Outflow sampling dates (Table B2-3). Specific duplicate samples were not collected for the marine samples, but instead a split sample analysis was used for the top field sample collected in Hope Bay in August (Table B2-3).

All blank and duplicate samples were submitted to appropriate laboratories and tested for the same major parameters as the field samples. The marine field sample selected for QC testing was split in the laboratory and analyzed for selected parameters (Table B2.3).

Although parameter results should not have been detected in the field or equipment blanks, parameter concentrations were considered notable if they were greater than five times the corresponding MRV. This threshold is based on the Practical Quantitation Limit defined by U.S. EPA (1985), which takes into account the potential for data accuracy error when parameter concentrations approach or are below MRVs.

Notable results observed in the blanks were evaluated relative to parameter concentrations observed in field samples collected during the corresponding sampling trip to determine if sample contamination was limited to that particular QC sample or was apparent in other samples collected at that time. If, based on this comparison, sample contamination did not appear to have been an isolated error, field data were flagged and interpreted with this limitation in mind.

For all calculations, including relative percent difference (RPD), values below the MRV were set to half the MRV. Differences between parameter concentrations in the duplicate water samples were considered notable if:

- the RPD was greater than 20 percent (%); and
- the concentration was greater than five times the relevant reported MRV.

This threshold takes into account the potential for analytical uncertainty when concentrations approach MRVs (Weiner 2000). These criteria are consistent with those used by analytical laboratories for their internal QC procedures. Variability between duplicate and internal laboratory split samples was rated as follows:

- ***low***, if less than 10% of the parameters included in the duplicate or split sample analysis were notably different from one another;

- ***moderate***, if 10 to 30% of the parameters included in the duplicate or split sample analysis were notably different from one another; and
- ***high***, if more than 30% of the parameters included in the duplicate or split sample analysis were notably different from one another.

## B2.2 QA/QC RESULTS

Field and equipment blanks were analyzed for physical parameters (e.g., lab pH, lab conductivity), total and dissolved nutrients, organic carbon, major ions, total and dissolved metals, radium-226, totals cyanide, fluoride and sulphide. Laboratory results are presented in Table B2.2. Notables in the blanks were common (Table B2.1; only parameters with reported MRVs are presented), however, greater than half of the notables had concentrations far less than the corresponding parameter concentrations from the field samples. Notables with concentrations similar to corresponding field samples rarely occurred for parameters of concern, such as ammonia, aluminum, mercury, etc. This suggests that contamination of field samples had little effect on interpretation of the data

Duplicate samples were analyzed for the same parameters as field and equipment blanks, with the exception of three dissolved metals (thallium, tin and titanium) (Table B2.2; only parameters with reported MRVs are presented). Thirteen percent of all parameters showed differences greater than 20%, indicating that laboratory variability was moderate.

The marine laboratory split sample was used to evaluate only select parameters (total phosphorus; dissolved calcium, magnesium, potassium, sodium and sulphur; and dissolved metals) (Table B2-4). Of those parameters, 29% showed differences greater 20% indicating that laboratory variability was moderate.

**Table B2.1 Analytical results for QA/QC samples, 2008.**

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Fickle Duck Lake Equipment Blank | | | Patch Lake Equipment Blank | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 19-Jul-08 | 14-Aug-08 | 9-Sep-08 | 24-May-08 | 17-Jul-08 | 15-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 1.6 | 1.9 | 1.7 | 9.6 | 1.8 | 2.4 | 2.2 |
| Specific Conductivity | µs/cm | 0.1 | | 1.3 | 1 | 1.5 | 26.9 | 1.6 | 1.1 | 4.2 |
| Total Dissolved Solids | mg/L | 0.1 | 6.5 - 9.0 | 3.7 | 4.6 | 3.9 | 19 | 3.9 | 4.2 | 5.2 |
| Total Suspended Solids | mg/L | 1 | | <1 | <1 | <1 | <1 | <1 | 2 | <1 |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 0.02 | 0.06 | 0.03 | 0.14 | 0.09 | 0.06 | 0.66 |
| True Color | TCU | 1 | | <1 | <1 | <1 | 6 | <1 | <1 | 10 |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.001 | 0.003 | 0.001 | 0.001 | 0.001 | 0.002 | 0.004 |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.04 | <0.01 | 0.02 | 0.04 | 0.02 | <0.01 | 0.02 |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.004 | 0.004 | 0.003 | 0.009 | 0.008 | 0.002 | 0.002 |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | <0.005 | <0.005 | 0.005 | <0.005 | 0.005 | <0.005 |
| Nitrite as N | mg/L | 0.001 | 0.06 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 0.3 | 0.2 | 0.3 | 0.6 | 0.2 | 0.2 | 0.3 |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 2 | 2 | 2 | 12 | 2 | 3 | 3 |
| Calcium (total) | mg/L | 0.004 | | 0.0147 | 0.0128 | 0.0064 | 0.0257 | 0.0048 | 0.009 | 0.12 |
| Chloride | mg/L | 0.3 | | <0.3 | 0.4 | 0.3 | 4.6 | <0.3 | <0.3 | 0.9 |
| Magnesium (total) | mg/L | 0.0001 | | 0.0008 | 0.0071 | 0.0029 | 0.0192 | 0.0007 | 0.009 | 0.0966 |
| Potassium (total) | µg/L | 2.0 | | <2 | <2 | <2 | 0.4 | <2 | 5.79 | 53.3 |
| Sodium (total) | µg/L | 2.0 | | <2 | <2 | <2 | 6.2 | <2 | 57.2 | 472 |
| Sulfate | mg/L | 2.0 | | <3 | <3 | <3 | <3 | <3 | <3 | <3 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 0.54 | 13.8 | <0.5 | 1.87 | <0.5 | 7.42 | 5.16 |
| Antimony | µg/L | 0.0005 | | 0.0016 | 0.0058 | 0.0042 | 0.284 | 0.0037 | 0.0041 | 0.0088 |
| Arsenic | µg/L | 0.002 | 5 | <0.002 | 0.0091 | <0.002 | 0.0601 | 0.0128 | 0.0022 | <0.02 |
| Barium | µg/L | 0.004 | | 0.0367 | 0.0671 | 0.0723 | 0.0075 | 0.0222 | 0.0417 | 0.14 |
| Beryllium | µg/L | 0.003 | | <0.003 | 0.0043 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | 0.001 | | <0.001 | <0.001 | 0.0012 | <0.001 | <0.001 | <0.001 | 0.0016 |
| Boron | µg/L | 0.03 | | 0.249 | 0.291 | 0.487 | 7.18 | 0.759 | 0.466 | 0.55 |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | <0.002 | <0.002 | 0.0024 | <0.002 | <0.002 | 0.0023 | 0.0023 |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.153 | 0.072 | <0.04 | <0.03 | 0.113 | <0.04 | 0.049 |
| Cobalt | µg/L | 0.001 | | 0.0014 | 0.0019 | 0.0017 | <0.001 | 0.0014 | <0.001 | 0.0033 |
| Copper | µg/L | 0.05 | 2 - 4 | <0.05 | <0.05 | 0.0673 | <0.05 | 0.153 | 0.0833 | 0.203 |
| Iron | µg/L | 2 | 300 | <2 | <2 | <2 | <2 | <2 | <2 | 7.17 |
| Lead | µg/L | 0.001 | 1 - 7 | 0.0082 | 0.0127 | 0.0158 | <0.001 | 0.0126 | <0.001 | 0.0558 |
| Manganese | µg/L | 0.003 | | 0.0314 | 0.0304 | 0.0968 | <0.003 | 0.0354 | 0.0139 | 0.265 |
| Mercury | ng/L | 0.6 | 26 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 0.001 | 73 | <0.001 | 0.0022 | 0.004 | <0.001 | 0.008 | 0.0046 | 0.0071 |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.0498 | 0.0472 | <0.005 | <0.005 | 0.0066 | 0.0132 | 0.0247 |
| Selenium | µg/L | 0.1 | 1 | <0.04 | <0.04 | <0.1 | 0.197 | <0.1 | <0.1 | <0.04 |
| Silver | µg/L | 0.0005 | 0.1 | <0.0005 | <0.0005 | <0.0005 | 0.0029 | 0.0015 | <0.0005 | <0.0005 |
| Strontium | µg/L | 0.004 | | 0.0502 | 0.0598 | 0.0274 | 0.152 | 0.03 | 0.0604 | 0.547 |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0003 | 0.0003 | 0.0004 | 0.0003 | 0.0015 | <0.0003 | 0.0008 |
| Tin | µg/L | 0.03 | | 0.03 | 0.03 | 0.0756 | 1.02 | 0.0681 | 0.03 | 0.139 |
| Uranium | µg/L | 0.0001 | | 0.0001 | 0.0002 | 0.0003 | 0.001 | 0.0002 | 0.0003 | 0.0019 |
| Vanadium | µg/L | 0.005 | | 0.0462 | 0.0391 | <0.005 | <0.01 | 0.046 | 0.0104 | 0.027 |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 0.14 | 0.262 | 0.347 | <0.1 | 0.239 | 2.26 | 0.264 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | <0.2 | 0.321 | 0.404 | <0.2 | <0.2 | <0.2 | 0.552 |
| Antimony | µg/L | 0.0005 | | 0.00154 | 0.0058 | 0.0042 | 0.281 | 0.0036 | 0.004 | 0.0087 |
| Arsenic | µg/L | 0.002 | | <0.002 | 0.009 | <0.002 | 0.0595 | 0.0127 | 0.0022 | <0.02 |
| Barium | µg/L | 0.004 | | 0.004 | 0.027 | 0.0137 | <0.004 | <0.004 | 0.0146 | 0.0774 |
| Beryllium | µg/L | 0.003 | | <0.003 | 0.0042 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | 0.001 | | - | - | - | - | - | - | - |
| Boron | µg/L | 0.03 | | 0.03 | 0.185 | 0.03 | 6.43 | 0.099 | 0.151 | 0.545 |
| Cadmium | µg/L | 0.002 | | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.0021 |
| Chromium | µg/L | 0.03 | | 0.151 | 0.055 | <0.04 | <0.03 | 0.112 | <0.04 | 0.041 |
| Cobalt | µg/L | 0.001 | | 0.0013 | 0.0019 | 0.0017 | <0.001 | <0.001 | <0.001 | 0.0032 |
| Copper | µg/L | 0.05 | | <0.05 | <0.05 | 0.0666 | <0.05 | 0.0926 | 0.082 | 0.187 |
| Iron | µg/L | 2 | | <2 | <2 | <2 | <2 | <2 | <2 | <2 |
| Lead | µg/L | 0.001 | | <0.001 | 0.0108 | 0.0052 | <0.001 | 0.0125 | <0.001 | 0.0066 |
| Manganese | µg/L | 0.003 | | <0.003 | 0.0301 | 0.0364 | 0.00756 | 0.0076 | 0.0138 | 0.19 |
| Molybdenum | µg/L | 0.6 | | <0.001 | 0.0022 | 0.0039 | <0.001 | 0.0016 | 0.0026 | 0.007 |
| Nickel | µg/L | 0.001 | | 0.0493 | 0.0467 | <0.005 | <0.005 | 0.005 | 0.0131 | 0.0245 |
| Selenium | µg/L | 0.005 | | <0.04 | <0.04 | <0.04 | 0.195 | <0.1 | <0.1 | <0.04 |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | <0.0005 | 0.0024 | 0.0007 | <0.0005 | <0.0005 |
| Strontium | µg/L | 0.0005 | | 0.0497 | 0.0592 | 0.024 | 0.15 | 0.0212 | 0.0598 | 0.542 |
| Thallium | µg/L | 0.004 | | - | - | - | - | - | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | - | - | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | - | - | - | - |
| Uranium | µg/L | 0.0001 | | <0.0001 | <0.0001 | 0.0001 | 0.0005 | 0.0001 | 0.0001 | 0.0006 |
| Vanadium | µg/L | 0.005 | | 0.0457 | <0.01 | <0.005 | <0.01 | 0.0452 | 0.0103 | 0.0151 |
| Zinc | µg/L | 0.05 | | 0.083 | 0.168 | 0.196 | <0.05 | 0.144 | 2.2 | 0.261 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | - |

[a] Guidelines are explained in Appendix B1.

**Table B2.1 Analytical results for QA/QC samples, 2008.**

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Doris Lake Field Blank | | | | Patch Outflow Field Blank | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-May-08 | 16-Jul-08 | 17-Aug-08 | 12-Sep-08 | 21-Jun-08 | 17-Jul-08 | 20-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 35.2 | 30.2 | 27.1 | 27.4 | 1.4 | 1.6 | 2 | 1.9 |
| Specific Conductivity | µs/cm | 0.1 | | 326 | 299 | 266 | 267 | 1 | 1.2 | 1.5 | 1.4 |
| Total Dissolved Solids | mg/L | 0.1 | 6.5 - 9.0 | 174 | 143 | 129 | 123 | 3.6 | 3.8 | 4.8 | 4.3 |
| Total Suspended Solids | mg/L | 1 | | 2 | 3 | 4 | 6 | <1 | <1 | <1 | <1 |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 55.7 | 49.2 | 45.7 | 45.9 | 0.09 | 0.08 | 0.09 | 0.09 |
| True Color | TCU | 1 | | 15 | 15 | 12 | 15 | <1 | <1 | <1 | <1 |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.027 | 0.034 | 0.028 | 0.033 | <0.001 | <0.001 | 0.006 | 0.003 |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.58 | 0.48 | 0.51 | 0.6 | 0.04 | 0.04 | 0.04 | 0.01 |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.004 | 0.011 | 0.04 | 0.006 | 0.003 | 0.005 | 0.006 | 0.002 |
| Nitrite+Nitrate as N | mg/L | 0.005 | | 0.006 | 0.014 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite as N | mg/L | 0.001 | 0.06 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 6.4 | 6.6 | 5.8 | 5.5 | <0.2 | 0.4 | 0.2 | 0.4 |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 43 | 37 | 33 | 33 | 2 | 2 | 2 | 2 |
| Calcium (total) | mg/L | 0.004 | | 8.94 | 7.87 | 7.33 | 7.66 | <0.004 | <0.004 | <0.004 | 0.0045 |
| Chloride | mg/L | 0.3 | | 82 | 69.6 | 61.5 | 60.7 | <0.3 | <0.3 | <0.3 | 0.5 |
| Magnesium (total) | mg/L | 0.0001 | | 8.43 | 7 | 6.52 | 6.65 | 0.0002 | 0.0001 | 0.0006 | 0.0013 |
| Potassium (total) | µg/L | 2.0 | | 2790 | 2560 | 2400 | 2370 | <2 | <2 | <2 | <2 |
| Sodium (total) | µg/L | 2.0 | | 40500 | 35000 | 33600 | 32500 | <2 | <2 | <2 | <2 |
| Sulfate | mg/L | 2.0 | | 5 | <3 | 4 | <3 | <3 | <3 | <3 | <3 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 7.08 | 54.1 | 67.1 | 50.1 | 0.57 | <0.5 | <0.5 | <0.5 |
| Antimony | µg/L | 0.0005 | | 0.146 | 0.0154 | 0.0154 | 0.0202 | 0.0017 | 0.003 | 0.0035 | 0.0017 |
| Arsenic | µg/L | 0.002 | 5 | 0.609 | 0.497 | 0.587 | 0.493 | 0.0062 | 0.0023 | 0.0099 | 0.0075 |
| Barium | µg/L | 0.004 | | 3.32 | 3.68 | 3.46 | 3.17 | <0.004 | 0.0114 | 0.0164 | 0.019 |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | 0.001 | | 0.0018 | <0.001 | <0.001 | 0.0056 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | µg/L | 0.03 | | 28.7 | 24.9 | 23.9 | 22.5 | 0.153 | 0.686 | 0.478 | 0.381 |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | <0.002 | <0.002 | 0.0024 | 0.0051 | <0.002 | <0.002 | 0.0057 | <0.002 |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.207 | 0.228 | 0.173 | 0.294 | 0.156 | 0.0695 | <0.03 | 0.0399 |
| Cobalt | µg/L | 0.001 | | 0.0211 | 0.0613 | 0.0353 | 0.0416 | <0.001 | 0.0013 | <0.001 | <0.001 |
| Copper | µg/L | 0.05 | 2 - 4 | 1.39 | 1.61 | 1.4 | 1.68 | <0.05 | 0.0749 | <0.05 | 0.0662 |
| Iron | µg/L | 2 | 300 | 7.93 | 217 | 82.5 | 74.2 | <2 | <2 | <2 | <2 |
| Lead | µg/L | 0.001 | 1 - 7 | <0.001 | 0.0475 | 0.0243 | 0.152 | 0.0449 | 0.0058 | <0.001 | <0.001 |
| Manganese | µg/L | 0.003 | | 3.47 | 50.7 | 14.9 | 9.72 | 0.0074 | 0.0083 | <0.003 | 0.0723 |
| Mercury | ng/L | 0.6 | 26 | <0.6 | 1.7 | 1.9 | 0.9 | <0.6 | <0.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 0.001 | 73 | 0.158 | 0.137 | 0.139 | 0.154 | <0.001 | 0.0032 | 0.0094 | <0.001 |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.349 | 0.456 | 0.421 | 0.461 | 0.0103 | <0.005 | <0.005 | <0.005 |
| Selenium | µg/L | 0.1 | 1 | 0.165 | <0.1 | 1.26 | 1.07 | <0.1 | 0.128 | <0.1 | <0.1 |
| Silver | µg/L | 0.0005 | 0.1 | 0.0016 | 0.0011 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | 0.004 | | 50.1 | 42.8 | 37.9 | 38.9 | 0.0074 | 0.0171 | 0.004 | 0.0134 |
| Thallium | µg/L | 0.0003 | 0.8 | <0.0003 | 0.0024 | 0.0032 | 0.0048 | <0.0003 | 0.0012 | 0.0012 | <0.0003 |
| Tin | µg/L | 0.03 | | 1.16 | 0.03 | 0.03 | 0.0668 | 0.032 | 0.0329 | 0.03 | 0.03 |
| Uranium | µg/L | 0.0001 | | 0.0345 | 0.0338 | 0.0328 | 0.0339 | 0.0001 | 0.0002 | 0.0002 | 0.0002 |
| Vanadium | µg/L | 0.005 | | <0.01 | 0.103 | 0.095 | 0.16 | 0.0533 | 0.0195 | 0.033 | <0.01 |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | <0.1 | 0.615 | 0.599 | <0.1 | 0.159 | 0.157 | 0.29 | 0.232 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | 0.907 | 5.91 | 5.38 | 5.6 | <0.2 | <0.2 | <0.2 | 0.328 |
| Antimony | µg/L | 0.0005 | | 0.145 | 0.0152 | 0.0152 | 0.02 | 0.00169 | 0.00297 | 0.00349 | 0.00167 |
| Arsenic | µg/L | 0.002 | | 0.562 | 0.4 | 0.501 | 0.488 | 0.0061 | 0.0022 | 0.0098 | 0.0074 |
| Barium | µg/L | 0.004 | | 2.94 | 2.85 | 2.51 | 2.49 | <0.004 | 0.0113 | 0.004 | <0.004 |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | 0.001 | | - | - | - | - | - | - | - | - |
| Boron | µg/L | 0.03 | | 27.4 | 23.1 | 22 | 21.5 | 0.098 | <0.03 | 0.276 | 0.38 |
| Cadmium | µg/L | 0.002 | | <0.002 | <0.002 | <0.002 | 0.0021 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | 0.03 | | 0.205 | 0.226 | 0.171 | 0.258 | 0.0809 | 0.0688 | <0.03 | 0.0352 |
| Cobalt | µg/L | 0.001 | | 0.0186 | 0.0165 | 0.0165 | 0.0274 | <0.001 | 0.0013 | 0.0063 | 0.0014 |
| Copper | µg/L | 0.05 | | 1.38 | 1.45 | 1.39 | 1.66 | <0.05 | 0.074 | <0.05 | 0.055 |
| Iron | µg/L | 2 | | <2 | 56.5 | 5.31 | 12.1 | <2 | <2 | <2 | <2 |
| Lead | µg/L | 0.001 | | <0.001 | 0.0108 | 0.0065 | 0.0189 | <0.001 | 0.0018 | 0.0032 | 0.001 |
| Manganese | µg/L | 0.003 | | 2.44 | 16.1 | 0.112 | 0.159 | 0.0074 | 0.0082 | <0.003 | 0.0104 |
| Molybdenum | µg/L | 0.6 | | 0.155 | 0.135 | 0.132 | 0.139 | <0.001 | 0.0031 | 0.0013 | <0.001 |
| Nickel | µg/L | 0.001 | | 0.147 | 0.307 | 0.176 | 0.253 | 0.0102 | <0.005 | <0.005 | <0.005 |
| Selenium | µg/L | 0.005 | | 0.162 | <0.1 | 0.887 | 0.77 | <0.1 | <0.1 | <0.1 | <0.1 |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | 0.0005 | | 48 | 40.9 | 37.1 | 38.5 | 0.0073 | 0.0169 | 0.004 | 0.0133 |
| Thallium | µg/L | 0.004 | | - | - | - | - | - | - | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | - | - | - | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | - | - | - | - | - |
| Uranium | µg/L | 0.0001 | | 0.0272 | 0.0274 | 0.0264 | 0.0295 | <0.0001 | 0.0001 | 0.0001 | 0.0002 |
| Vanadium | µg/L | 0.005 | | <0.01 | 0.054 | 0.04 | 0.092 | 0.0312 | 0.0193 | 0.02 | <0.01 |
| Zinc | µg/L | 0.05 | | <0.05 | 0.556 | 0.593 | <0.05 | 0.057 | 0.155 | 0.187 | <0.05 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | - | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |

[a] Guidelines are explained in Appendix B1.

**Table B2.1 Analytical results for QA/QC samples, 2008.**

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Reference Outflow Field Blank | | | | Tail Lake Field Blank | | | Radium-226 Trip Blank | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-Jun-08 | 18-Jul-08 | 15-Aug-08 | 9-Sep-08 | 16-Jul-08 | 18-Aug-08 | 11-Sep-08 | 21-Jun-08 | 3-Jul-08 |
| **Physical** | | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 1.4 | 2.4 | 2 | 1.8 | 1.6 | 2 | 1.9 | - | - |
| Specific Conductivity | µs/cm | 0.1 | | 1 | 1.1 | 1.3 | 1.5 | 1.3 | 1.2 | 1.4 | - | - |
| Total Dissolved Solids | mg/L | 0.1 | 6.5 - 9.0 | 7.6 | 4.3 | 4 | 4.1 | 3.8 | 4 | 4.2 | - | - |
| Total Suspended Solids | mg/L | 1 | | <1 | <1 | <1 | <1 | <1 | <1 | <1 | - | - |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 0.09 | 0.08 | 0.09 | 0.08 | 0.09 | 0.02 | 0.09 | - | - |
| True Color | TCU | 1 | | <1 | <1 | <1 | <1 | <1 | <1 | 10 | - | - |
| **Nutrients** | | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.002 | 0.007 | 0.004 | 0.004 | 0.007 | 0.003 | 0.002 | - | - |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.02 | 0.04 | 0.01 | 0.02 | 0.01 | 0.03 | 0.01 | - | - |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.005 | 0.008 | 0.004 | 0.003 | 0.009 | 0.002 | 0.003 | - | - |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | <0.005 | <0.005 | <0.005 | 0.015 | 0.008 | <0.005 | - | - |
| Nitrite as N | mg/L | 0.001 | 0.06 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | - | - |
| **Organics** | | | | | | | | | | | | |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 0.3 | <0.2 | 0.2 | 0.3 | <0.2 | <0.2 | 0.3 | - | - |
| **Major Ions** | | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 2 | 3 | 2 | 2 | 2 | 2 | 2 | - | - |
| Calcium (total) | mg/L | 0.004 | | 0.0085 | 0.0046 | <0.004 | 0.0128 | <0.004 | <0.004 | <0.004 | - | - |
| Chloride | mg/L | 0.3 | | 0.4 | <0.3 | <0.3 | 0.4 | <0.3 | <0.3 | 0.4 | - | - |
| Magnesium (total) | mg/L | 0.0001 | | 0.0016 | 0.0002 | 0.0008 | 0.0133 | <0.0001 | 0.0006 | 0.0002 | - | - |
| Potassium (total) | µg/L | 2.0 | | 4.55 | <2 | <2 | <2 | <2 | <2 | <2 | - | - |
| Sodium (total) | µg/L | 2.0 | | 44.1 | <2 | <2 | <2 | <2 | <2 | <2 | - | - |
| Sulfate | mg/L | 2.0 | | 6 | <3 | <3 | <3 | <3 | <3 | <3 | - | - |
| **Total Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 2.98 | <0.5 | <0.5 | <0.5 | 0.545 | <0.5 | <0.5 | - | - |
| Antimony | µg/L | 0.0005 | | 0.0033 | <0.0005 | 0.0027 | 0.002 | 0.0029 | 0.0012 | 0.0033 | - | - |
| Arsenic | µg/L | 0.002 | 5 | <0.002 | 0.009 | 0.0227 | 0.0093 | 0.002 | 0.00256 | 0.005 | - | - |
| Barium | µg/L | 0.004 | | 0.0388 | 0.0075 | 0.0473 | 0.534 | 0.006 | 0.0067 | 0.0061 | - | - |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | - | - |
| Bismuth | µg/L | 0.001 | | 0.0034 | <0.001 | <0.001 | 0.0018 | <0.001 | <0.001 | 0.001 | - | - |
| Boron | µg/L | 0.03 | | 0.731 | 0.05 | 0.291 | 0.318 | 0.305 | 0.255 | 0.05 | - | - |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | 0.0059 | <0.002 | <0.002 | 0.0692 | <0.002 | <0.002 | <0.002 | - | - |
| Chromium | µg/L | 0.03 | 1 or 16 | <0.04 | 0.167 | 0.043 | 0.042 | <0.03 | <0.03 | <0.04 | - | - |
| Cobalt | µg/L | 0.001 | | 0.0038 | 0.0015 | 0.0014 | 0.0106 | <0.001 | <0.001 | 0.0016 | - | - |
| Copper | µg/L | 0.05 | 2 - 4 | 0.254 | <0.05 | <0.05 | 0.213 | 0.0816 | <0.05 | 0.0551 | - | - |
| Iron | µg/L | 2 | 300 | 4.35 | <2 | <2 | <2 | <2 | <2 | <2 | - | - |
| Lead | µg/L | 0.001 | 1 - 7 | 0.042 | <0.001 | 0.006 | 0.263 | 0.0023 | <0.001 | 0.0069 | - | - |
| Manganese | µg/L | 0.003 | | 0.0648 | <0.003 | <0.003 | 0.531 | 0.0046 | <0.003 | 0.0062 | - | - |
| Mercury | ng/L | 0.6 | 26 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | - | - |
| Molybdenum | µg/L | 0.001 | 73 | 0.0139 | <0.001 | 0.0032 | <0.001 | 0.013 | <0.001 | 0.0024 | - | - |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.155 | <0.005 | 0.0263 | 0.0316 | <0.005 | <0.005 | 0.0087 | - | - |
| Selenium | µg/L | 0.1 | 1 | <0.1 | 0.072 | 0.041 | <0.1 | <0.1 | 0.053 | 0.051 | - | - |
| Silver | µg/L | 0.0005 | 0.1 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0009 | <0.0005 | <0.0005 | - | - |
| Strontium | µg/L | 0.004 | | 0.0404 | 0.0088 | 0.022 | 0.0854 | 0.0058 | 0.01 | <0.004 | - | - |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0006 | <0.0003 | <0.0003 | 0.0006 | 0.0005 | <0.0003 | 0.00031 | - | - |
| Tin | µg/L | 0.03 | | 0.03 | 0.03 | 0.03 | 0.03 | 0.0472 | 0.03 | 0.03 | - | - |
| Uranium | µg/L | 0.0001 | | 0.0005 | <0.0001 | 0.0001 | 0.0017 | 0.0001 | 0.0001 | <0.0001 | - | - |
| Vanadium | µg/L | 0.005 | | 0.0095 | 0.0466 | <0.01 | 0.0566 | <0.005 | 0.0357 | <0.01 | - | - |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 0.942 | <0.1 | 0.176 | 0.309 | 0.166 | <0.1 | <0.1 | - | - |
| **Dissolved Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | <0.2 | <0.2 | <0.2 | 0.417 | <0.2 | <0.2 | 0.273 | - | - |
| Antimony | µg/L | 0.0005 | | 0.00331 | 0.0005 | 0.00271 | 0.00197 | 0.00286 | 0.0012 | 0.00325 | - | - |
| Arsenic | µg/L | 0.002 | | <0.002 | 0.00212 | 0.0225 | 0.0073 | 0.0035 | 0.0025 | 0.005 | - | - |
| Barium | µg/L | 0.004 | | 0.0127 | <0.004 | <0.004 | 0.0187 | <0.004 | <0.004 | 0.0061 | - | - |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | - | - |
| Bismuth | µg/L | 0.001 | | - | - | - | - | - | - | - | - | - |
| Boron | µg/L | 0.03 | | 0.156 | <0.03 | 0.288 | 0.296 | 0.042 | <0.03 | <0.03 | - | - |
| Cadmium | µg/L | 0.002 | | <0.002 | <0.002 | <0.002 | 0.0366 | <0.002 | <0.002 | <0.002 | - | - |
| Chromium | µg/L | 0.03 | | <0.04 | 0.165 | <0.03 | <0.03 | <0.03 | <0.03 | <0.04 | - | - |
| Cobalt | µg/L | 0.001 | | 0.0037 | 0.0012 | 0.0013 | 0.0039 | <0.001 | 0.0056 | <0.001 | - | - |
| Copper | µg/L | 0.05 | | 0.251 | <0.05 | <0.05 | 0.182 | 0.074 | <0.05 | 0.055 | - | - |
| Iron | µg/L | 2 | | 3.32 | <2 | <2 | <2 | <2 | <2 | <2 | - | - |
| Lead | µg/L | 0.001 | | 0.0029 | <0.001 | <0.001 | 0.0127 | <0.001 | <0.001 | 0.0068 | - | - |
| Manganese | µg/L | 0.003 | | 0.0282 | <0.003 | <0.003 | 0.146 | <0.003 | <0.003 | 0.0061 | - | - |
| Molybdenum | µg/L | 0.6 | | 0.0104 | <0.001 | 0.0013 | <0.001 | 0.0032 | <0.001 | 0.0024 | - | - |
| Nickel | µg/L | 0.001 | | 0.0279 | <0.005 | 0.02 | 0.0227 | <0.005 | <0.005 | <0.005 | - | - |
| Selenium | µg/L | 0.005 | | <0.1 | 0.071 | 0.041 | <0.1 | <0.1 | 0.052 | <0.04 | - | - |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | - | - |
| Strontium | µg/L | 0.0005 | | 0.04 | 0.0087 | 0.0218 | 0.0803 | 0.0057 | 0.0099 | <0.004 | - | - |
| Thallium | µg/L | 0.004 | | - | - | - | - | - | - | - | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | - | - | - | - | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | - | - | - | - | - | - |
| Uranium | µg/L | 0.0001 | | 0.0004 | 0.0001 | <0.0001 | 0.0001 | <0.0001 | 0.0001 | <0.0001 | - | - |
| Vanadium | µg/L | 0.005 | | 0.0094 | 0.046 | <0.01 | <0.005 | 0.0061 | 0.0353 | <0.01 | - | - |
| Zinc | µg/L | 0.05 | | 0.754 | <0.05 | 0.174 | 0.212 | <0.05 | 0.069 | 0.05 | - | - |
| **Radionuclides** | | | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 |

[a] Guidelines are explained in Appendix B1.

## Table B2.2 Notable results for QA/QC equipment blank and field blank samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Fickle Duck Lake Equipment Blank | | | Patch Lake Equipment Blank | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 19-Jul-08 | 14-Aug-08 | 9-Sep-08 | 24-May-08 | 17-Jul-08 | 15-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | | | | 9.6 | | | |
| Specific Conductivity | µs/cm | 0.1 | | 1.3 | 1 | 1.5 | 26.9 | 1.6 | 1.1 | 4.2 |
| Total Dissolved Solids | mg/L | 0.1 | | 3.7 | 4.6 | 3.9 | 19 | 3.9 | 4.2 | 5.2 |
| Total Suspended Solids | mg/L | 1 | | | | | | | | |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | | 0.06 | | 0.14 | 0.09 | 0.06 | 0.66 |
| True Color | TCU | 1 | | | | | 6 | | | 10 |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | | | | | | | |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | | | | | | | |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | | | | 0.009 | 0.008 | | |
| Nitrite+Nitrate as N | mg/L | 0.005 | | | | | | | | |
| Nitrite as N | mg/L | 0.001 | 0.06 | | | | | | | |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | | | | 12 | | | |
| Calcium (total) | mg/L | 0.004 | | | | | 0.026 | | | 0.120 |
| Chloride | mg/L | 0.3 | | | | | 4.6 | | | |
| Magnesium (total) | mg/L | 0.0001 | | 0.0008 | 0.0071 | 0.0029 | 0.0192 | 0.0007 | 0.0090 | 0.0966 |
| Potassium (total) | µg/L | 2.0 | | | | | | | | 53.3 |
| Sodium (total) | µg/L | 2.0 | | | | | | | 57.2 | 472.0 |
| Sulfate | mg/L | 2.0 | | | | | | | | |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | | 13.8 | | | | 7.4 | 5.2 |
| Antimony | µg/L | 0.0005 | | | 0.0058 | 0.0042 | 0.2840 | 0.0037 | 0.0041 | 0.0088 |
| Arsenic | µg/L | 0.002 | 5 | | | | 0.060 | 0.013 | | |
| Barium | µg/L | 0.004 | | 0.037 | 0.067 | 0.072 | | 0.022 | 0.042 | 0.140 |
| Beryllium | µg/L | 0.003 | | | | | | | | |
| Bismuth | µg/L | 0.001 | | | | | | | | |
| Boron | µg/L | 0.03 | | 0.25 | 0.29 | 0.49 | 7.18 | 0.76 | 0.47 | 0.55 |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | | | | | | | |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.15 | | | | | | |
| Cobalt | µg/L | 0.001 | | | | | | | | |
| Copper | µg/L | 0.05 | 2 - 4 | | | | | | | |
| Iron | µg/L | 2 | 300 | | | | | | | |
| Lead | µg/L | 0.001 | 1 - 7 | 0.008 | 0.013 | 0.016 | | 0.013 | | 0.056 |
| Manganese | µg/L | 0.003 | | 0.031 | 0.030 | 0.097 | | 0.035 | | 0.265 |
| Mercury | ng/L | 0.6 | 26 | | | | | | | |
| Molybdenum | µg/L | 0.001 | 73 | | | | | 0.008 | | 0.007 |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.050 | 0.047 | | | | | |
| Selenium | µg/L | 0.1 | 1 | | | | | | | |
| Silver | µg/L | 0.0005 | 0.1 | | | | 0.0029 | | | |
| Strontium | µg/L | 0.004 | | 0.050 | 0.060 | 0.027 | 0.152 | 0.030 | 0.060 | 0.547 |
| Thallium | µg/L | 0.0003 | 0.8 | | | | | | | |
| Tin | µg/L | 0.03 | | | | | 1.02 | | | |
| Uranium | µg/L | 0.0001 | | | | | 0.0010 | | | 0.0019 |
| Vanadium | µg/L | 0.005 | | 0.046 | 0.039 | | | 0.046 | | 0.027 |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | | | | | | 2.26 | |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | | | | | | | |
| Antimony | µg/L | 0.0005 | | | 0.0058 | 0.0042 | 0.2810 | 0.0036 | 0.0040 | 0.0087 |
| Arsenic | µg/L | 0.002 | | | | | 0.060 | 0.013 | | |
| Barium | µg/L | 0.004 | | | 0.027 | | | | | 0.077 |
| Beryllium | µg/L | 0.003 | | | | | | | | |
| Bismuth | µg/L | 0.001 | | | | | | | | |
| Boron | µg/L | 0.03 | | | 0.185 | | 6.43 | | 0.151 | 0.545 |
| Cadmium | µg/L | 0.002 | | | | | | | | |
| Chromium | µg/L | 0.03 | | 0.15 | | | | | | |
| Cobalt | µg/L | 0.001 | | | | | | | | |
| Copper | µg/L | 0.05 | | | | | | | | |
| Iron | µg/L | 2 | | | | | | | | |
| Lead | µg/L | 0.001 | | | 0.011 | 0.005 | | 0.013 | | 0.007 |
| Manganese | µg/L | 0.003 | | | 0.030 | 0.036 | | | | 0.190 |
| Molybdenum | µg/L | 0.6 | | | | | | | | |
| Nickel | µg/L | 0.001 | | 0.049 | 0.047 | | | | 0.013 | 0.025 |
| Selenium | µg/L | 0.005 | | | | | 0.195 | | | |
| Silver | µg/L | 0.1 | | | | | | | | |
| Strontium | µg/L | 0.0005 | | 0.0497 | 0.0592 | 0.0240 | 0.1500 | 0.0212 | 0.0598 | 0.5420 |
| Thallium | µg/L | 0.004 | | | | | | | | |
| Tin | µg/L | 0.0003 | | | | | | | | |
| Titanium | µg/L | 0.03 | | | | | | | | |
| Uranium | µg/L | 0.0001 | | | | | | | | 0.0006 |
| Vanadium | µg/L | 0.005 | | 0.046 | | | | 0.045 | | |
| Zinc | µg/L | 0.05 | | | | | | | 2.20 | 0.26 |

[a] Guidelines are explained in Appendix B1.

Notables are > 5 times the MRV.

Notables are highlighted in yellow if concentrations are > 10% of the corresponding field value concentrations.

There were no notables for radium-226 or Dissolved Organic Carbon blanks.

## Table B2.2 Notable results for QA/QC equipment blank and field blank samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Patch Outflow Field Blank | | | | Reference Outflow Field Blank | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 21-Jun-08 | 17-Jul-08 | 20-Aug-08 | 10-Sep-08 | 24-Jun-08 | 18-Jul-08 | 15-Aug-08 | 9-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | | | | | | | | |
| Specific Conductivity | µs/cm | 0.1 | | 1 | 1.2 | 1.5 | 1.4 | 1 | 1.1 | 1.3 | 1.5 |
| Total Dissolved Solids | mg/L | 0.1 | | 3.6 | 3.8 | 4.8 | 4.3 | 7.6 | 4.3 | 4 | 4.1 |
| Total Suspended Solids | mg/L | 1 | | | | | | | | | |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 |
| True Color | TCU | 1 | | | | | | | | | |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | | | 0.006 | | | 0.007 | | |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | | | | | | | | |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | | | 0.006 | | | 0.008 | | |
| Nitrite+Nitrate as N | mg/L | 0.005 | | | | | | | | | |
| Nitrite as N | mg/L | 0.001 | 0.06 | | | | | | | | |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | | | | | | | | |
| Calcium (total) | mg/L | 0.004 | | | | | | | | | |
| Chloride | mg/L | 0.3 | | | | | | | | | |
| Magnesium (total) | mg/L | 0.0001 | | | | 0.0006 | 0.0013 | 0.0016 | | 0.0008 | 0.0133 |
| Potassium (total) | µg/L | 2.0 | | | | | | | | | |
| Sodium (total) | µg/L | 2.0 | | | | | | 44.1 | | | |
| Sulfate | mg/L | 2.0 | | | | | | | | | |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | | | | | 3.0 | | | |
| Antimony | µg/L | 0.0005 | | | 0.0030 | 0.0035 | | 0.0033 | | 0.0027 | |
| Arsenic | µg/L | 0.002 | 5 | | | | | | | 0.023 | |
| Barium | µg/L | 0.004 | | | | | | 0.039 | | 0.047 | 0.534 |
| Beryllium | µg/L | 0.003 | | | | | | | | | |
| Bismuth | µg/L | 0.001 | | | | | | | | | |
| Boron | µg/L | 0.03 | | 0.15 | 0.69 | 0.48 | 0.38 | 0.73 | | 0.29 | 0.32 |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | | | | | | | | 0.069 |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.16 | | | | | 0.17 | | |
| Cobalt | µg/L | 0.001 | | | | | | | | | 0.011 |
| Copper | µg/L | 0.05 | 2 - 4 | | | | | 0.25 | | | |
| Iron | µg/L | 2 | 300 | | | | | | | | |
| Lead | µg/L | 0.001 | 1 - 7 | 0.045 | 0.006 | | | 0.042 | | 0.006 | 0.263 |
| Manganese | µg/L | 0.003 | | | | | 0.072 | 0.065 | | | 0.531 |
| Mercury | ng/L | 0.6 | 26 | | | | | | | | |
| Molybdenum | µg/L | 0.001 | 73 | | | 0.009 | | 0.014 | | | |
| Nickel | µg/L | 0.005 | 25 - 150 | | | | | 0.155 | | 0.026 | 0.032 |
| Selenium | µg/L | 0.1 | 1 | | | | | | | | |
| Silver | µg/L | 0.0005 | 0.1 | | | | | | | | |
| Strontium | µg/L | 0.004 | | | | | | 0.040 | | 0.022 | 0.085 |
| Thallium | µg/L | 0.0003 | 0.8 | | | | | | | | |
| Tin | µg/L | 0.03 | | | | | | | | | |
| Uranium | µg/L | 0.0001 | | | | | | | | | 0.0017 |
| Vanadium | µg/L | 0.005 | | 0.053 | | 0.033 | | | 0.047 | | 0.057 |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | | | | | 0.942 | | | |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | | | | | | | | |
| Antimony | µg/L | 0.0005 | | | 0.0030 | 0.0035 | | 0.0033 | | 0.0027 | |
| Arsenic | µg/L | 0.002 | | | | | | | | 0.023 | |
| Barium | µg/L | 0.004 | | | | | | | | | |
| Beryllium | µg/L | 0.003 | | | | | | | | | |
| Bismuth | µg/L | 0.001 | | | | | | | | | |
| Boron | µg/L | 0.03 | | | | 0.276 | 0.38 | 0.156 | | 0.288 | 0.296 |
| Cadmium | µg/L | 0.002 | | | | | | | | | 0.037 |
| Chromium | µg/L | 0.03 | | | | | | | 0.17 | | |
| Cobalt | µg/L | 0.001 | | | | 0.006 | | | | | |
| Copper | µg/L | 0.05 | | | | | | 0.25 | | | |
| Iron | µg/L | 2 | | | | | | | | | |
| Lead | µg/L | 0.001 | | | | | | | | | 0.013 |
| Manganese | µg/L | 0.003 | | | | | | 0.028 | | | 0.146 |
| Molybdenum | µg/L | 0.6 | | | | | | | | | |
| Nickel | µg/L | 0.001 | | 0.010 | | | | 0.028 | | 0.020 | 0.023 |
| Selenium | µg/L | 0.005 | | | | | | | 0.071 | 0.041 | |
| Silver | µg/L | 0.1 | | | | | | | | | |
| Strontium | µg/L | 0.0005 | | 0.0073 | 0.0169 | 0.0040 | 0.0133 | 0.0400 | 0.0087 | 0.0218 | 0.0803 |
| Thallium | µg/L | 0.004 | | | | | | | | | |
| Tin | µg/L | 0.0003 | | | | | | | | | |
| Titanium | µg/L | 0.03 | | | | | | | | | |
| Uranium | µg/L | 0.0001 | | | | | | | | | |
| Vanadium | µg/L | 0.005 | | 0.031 | | | | | 0.046 | | |
| Zinc | µg/L | 0.05 | | | | | | 0.75 | | | |

[a] Guidelines are explained in Appendix B1.

Notables are > 5 times the MRV.

Notables are highlighted in yellow if concentrations are > 10% of the corresponding field value concentrations.

There were no notables for radium-226 or Dissolved Organic Carbon blanks.

## Table B2.2 Notable results for QA/QC equipment blank and field blank samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Tail Lake Field Blank | | |
|---|---|---|---|---|---|---|
| | | | | 16-Jul-08 | 18-Aug-08 | 11-Sep-08 |
| **Physical** | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | | | |
| Specific Conductivity | µs/cm | 0.1 | | 1.3 | 1.2 | 1.4 |
| Total Dissolved Solids | mg/L | 0.1 | | 3.8 | 4 | 4.2 |
| Total Suspended Solids | mg/L | 1 | | | | |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 0.09 | | 0.09 |
| True Color | TCU | 1 | | | | 10 |
| **Nutrients** | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.007 | | |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | | | |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.009 | | |
| Nitrite+Nitrate as N | mg/L | 0.005 | | | | |
| Nitrite as N | mg/L | 0.001 | 0.06 | | | |
| **Major Ions** | | | | | | |
| Bicarbonate | mg/L | 1 | | | | |
| Calcium (total) | mg/L | 0.004 | | | | |
| Chloride | mg/L | 0.3 | | | | |
| Magnesium (total) | mg/L | 0.0001 | | | 0.0006 | |
| Potassium (total) | µg/L | 2.0 | | | | |
| Sodium (total) | µg/L | 2.0 | | | | |
| Sulfate | mg/L | 2.0 | | | | |
| **Total Metals** | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | | | |
| Antimony | µg/L | 0.0005 | | 0.0029 | | 0.0033 |
| Arsenic | µg/L | 0.002 | 5 | | | |
| Barium | µg/L | 0.004 | | | | |
| Beryllium | µg/L | 0.003 | | | | |
| Bismuth | µg/L | 0.001 | | | | |
| Boron | µg/L | 0.03 | | 0.31 | 0.26 | |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | | | |
| Chromium | µg/L | 0.03 | 1 or 16 | | | |
| Cobalt | µg/L | 0.001 | | | | |
| Copper | µg/L | 0.05 | 2 - 4 | | | |
| Iron | µg/L | 2 | 300 | | | |
| Lead | µg/L | 0.001 | 1 - 7 | | | 0.007 |
| Manganese | µg/L | 0.003 | | | | |
| Mercury | ng/L | 0.6 | 26 | | | |
| Molybdenum | µg/L | 0.001 | 73 | 0.013 | | |
| Nickel | µg/L | 0.005 | 25 - 150 | | | |
| Selenium | µg/L | 0.1 | 1 | | | |
| Silver | µg/L | 0.0005 | 0.1 | | | |
| Strontium | µg/L | 0.004 | | | | |
| Thallium | µg/L | 0.0003 | 0.8 | | | |
| Tin | µg/L | 0.03 | | | | |
| Uranium | µg/L | 0.0001 | | | | |
| Vanadium | µg/L | 0.005 | | | 0.036 | |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | | | |
| **Dissolved Metals** | | | | | | |
| Aluminum | µg/L | 0.2 | | | | |
| Antimony | µg/L | 0.0005 | | 0.0029 | | 0.0033 |
| Arsenic | µg/L | 0.002 | | | | |
| Barium | µg/L | 0.004 | | | | |
| Beryllium | µg/L | 0.003 | | | | |
| Bismuth | µg/L | 0.001 | | | | |
| Boron | µg/L | 0.03 | | | | |
| Cadmium | µg/L | 0.002 | | | | |
| Chromium | µg/L | 0.03 | | | | |
| Cobalt | µg/L | 0.001 | | | 0.006 | |
| Copper | µg/L | 0.05 | | | | |
| Iron | µg/L | 2 | | | | |
| Lead | µg/L | 0.001 | | | | 0.007 |
| Manganese | µg/L | 0.003 | | | | |
| Molybdenum | µg/L | 0.6 | | | | |
| Nickel | µg/L | 0.001 | | | | |
| Selenium | µg/L | 0.005 | | | 0.052 | |
| Silver | µg/L | 0.1 | | | | |
| Strontium | µg/L | 0.0005 | | 0.0057 | 0.0099 | |
| Thallium | µg/L | 0.004 | | | | |
| Tin | µg/L | 0.0003 | | | | |
| Titanium | µg/L | 0.03 | | | | |
| Uranium | µg/L | 0.0001 | | | | |
| Vanadium | µg/L | 0.005 | | | 0.035 | |
| Zinc | µg/L | 0.05 | | | | |

[a] Guidelines are explained in Appendix B1.

Notables are > 5 times the MRV.

Notables are highlighted in yellow if concentrations are > 10% of the corresponding field value concentrations.

There were no notables for radium-226 or Dissolved Organic Carbon blanks.

## Table B2.3 Notable results for QA/QC field duplicate samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Stickleback Lake Field 18-Jul-08 | | | Stickleback Lake Field 14-Aug-08 | | | Stickleback Lake Field 9-Sep-08 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | sample | duplicate | RPD | sample | duplicate | RPD | sample | duplicate | RPD |
| **Physical** | | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 31.7 | 31.8 | 0% | 32.4 | 32.3 | 0% | 32.1 | 32.3 | 1% |
| Specific Conductivity | µs/cm | 0.1 | | 224 | 224 | 0% | 232 | 232 | 0% | 240 | 240 | 0% |
| Total Dissolved Solids | mg/L | 0.1 | | 105 | 105 | 0% | 110 | 110 | 0% | 115 | 114 | 1% |
| Total Suspended Solids | mg/L | 1 | | <1 | <1 | - | <1 | <1 | - | <1 | <1 | - |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 63.4 | 63.1 | 0% | 66 | 66.6 | 1% | 74.1 | 73.5 | 1% |
| True Color | TCU | 1 | | <1 | <1 | - | <1 | <1 | - | 12 | <1 | - |
| **Nutrients** | | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.007 | 0.012 | **53%** | 0.013 | 0.014 | 7% | 0.012 | 0.012 | 0% |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.28 | 0.3 | 7% | 0.33 | 0.33 | 0% | 0.37 | 0.36 | 3% |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.007 | 0.005 | - | 0.006 | 0.006 | 0% | 0.005 | 0.006 | - |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | <0.005 | - | <0.005 | <0.005 | - | <0.005 | <0.005 | - |
| Nitrite as N | mg/L | 0.001 | 0.06 | <0.001 | <0.001 | - | <0.001 | <0.001 | - | <0.001 | <0.001 | - |
| **Organics** | | | | | | - | | | - | | | - |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 3.8 | 3.7 | 3% | 5.1 | 5.2 | 2% | 4.9 | 4.6 | 6% |
| **Major Ions** | | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 39 | 39 | 0% | 39 | 39 | 0% | 39 | 39 | 0% |
| Calcium (total) | mg/L | 0.004 | | 16.3 | 15.6 | 4% | 16.1 | 16.7 | 4% | 17.8 | 16.8 | 6% |
| Chloride | mg/L | 0.3 | | 47.2 | 46.8 | 1% | 50 | 49.4 | 1% | 52 | 51.4 | 1% |
| Magnesium (total) | mg/L | 0.0001 | | 6.2 | 5.97 | 4% | 6.03 | 6.35 | 5% | 6.72 | 6.27 | 7% |
| Potassium (total) | µg/L | 2 | | 1750 | 1670 | 5% | 1670 | 1750 | 5% | 1760 | 1650 | 6% |
| Sodium (total) | µg/L | 2 | | 14900 | 14200 | 5% | 14100 | 15400 | 9% | 15600 | 14700 | 6% |
| Sulfate | mg/L | 3 | | <3 | <3 | - | <3 | <3 | - | <3 | <3 | - |
| **Total Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 18.6 | 19 | 2% | 15.7 | 14.9 | 5% | 27.1 | 49.8 | **59%** |
| Antimony | µg/L | 0.0005 | | 0.0068 | 0.0052 | **27%** | 0.0055 | 0.0063 | 14% | 0.0073 | 0.0073 | 0% |
| Arsenic | µg/L | 0.002 | 5 | 0.418 | 0.393 | 6% | 0.517 | 0.487 | 6% | 0.426 | 0.408 | 4% |
| Barium | µg/L | 0.004 | | 6.35 | 6.58 | 4% | 5.8 | 5.94 | 2% | 5.85 | 5.69 | 3% |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | - | 0.0065 | 0.003 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | 0.0165 | <0.001 | - | 0.0022 | <0.001 | - | <0.001 | 0.0022 | - |
| Boron | µg/L | 0.03 | | 15.5 | 14.2 | 9% | 16.1 | 17.1 | 6% | 16.7 | 16.8 | 1% |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | 0.0053 | 0.0085 | - | <0.002 | 0.0029 | - | <0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.077 | 0.193 | - | 0.27 | 0.106 | - | 0.177 | 0.145 | - |
| Cobalt | µg/L | 0.001 | | 0.0488 | 0.0466 | 5% | 0.0361 | 0.0344 | 5% | 0.0419 | 0.0343 | 20% |
| Copper | µg/L | 0.05 | 2 - 4 | 0.354 | 0.295 | 18% | 0.34 | 0.403 | 17% | 0.449 | 0.407 | 10% |
| Iron | µg/L | 2 | 300 | 110 | 112 | 2% | 93.9 | 91.3 | 3% | 45.4 | 39.5 | 14% |
| Lead | µg/L | 0.001 | 1 - 7 | 0.0301 | 0.0294 | 2% | 0.0038 | 0.012 | - | 0.0247 | 0.0121 | **68%** |
| Manganese | µg/L | 0.003 | | 22.1 | 22.4 | 1% | 7.16 | 7.47 | 4% | 6.46 | 6.16 | 5% |
| Mercury | ng/L | 0.6 | 26 | <0.6 | <0.6 | - | <0.6 | <0.6 | - | <0.6 | 0.8 | - |
| Molybdenum | µg/L | 0.001 | 73 | 0.0283 | 0.0122 | **80%** | 0.0471 | 0.046 | 2% | 0.035 | 0.0481 | **32%** |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.119 | 0.154 | **26%** | 0.323 | 0.431 | **29%** | 0.177 | 0.142 | **22%** |
| Selenium | µg/L | 0.1 | 1 | 0.607 | 0.593 | 2% | 0.626 | 0.63 | 1% | 0.687 | 0.497 | - |
| Silver | µg/L | 0.0005 | 0.1 | 0.0013 | 0.0005 | - | 0.0038 | 0.0022 | - | <0.0005 | <0.0005 | - |
| Strontium | µg/L | 0.004 | | 90.1 | 89.1 | 1% | 93.6 | 94.2 | 1% | 96.1 | 94.7 | 1% |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0071 | <0.0003 | - | 0.0061 | 0.0016 | **117%** | 0.001 | 0.0039 | - |
| Tin | µg/L | 0.03 | | <0.03 | 0.03 | - | <0.03 | 0.0341 | - | <0.03 | 0.03 | - |
| Uranium | µg/L | 0.0001 | | 0.0088 | 0.0094 | 7% | 0.0097 | 0.0097 | 0% | 0.0095 | 0.0084 | 12% |
| Vanadium | µg/L | 0.005 | | 0.0127 | 0.066 | - | 0.052 | 0.0355 | **38%** | 0.0693 | 0.101 | **37%** |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 1.33 | 1.44 | 8% | 0.811 | 0.378 | - | 0.569 | 0.703 | **21%** |
| **Dissolved Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | 1.21 | 1.06 | 13% | 1.15 | 1.3 | 12% | 1.4 | 1.25 | 11% |
| Antimony | µg/L | 0.0005 | | 0.0067 | 0.0052 | **25%** | 0.00545 | 0.0062 | 13% | 0.0072 | 0.0072 | 0% |
| Arsenic | µg/L | 0.002 | | 0.293 | 0.319 | 8% | 0.385 | 0.403 | 5% | 0.347 | 0.37 | 6% |
| Barium | µg/L | 0.004 | | 5.88 | 6.1 | 4% | 5.41 | 5.39 | 0% | 5.25 | 5.04 | 4% |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | - | <0.003 | <0.003 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | - | - | - | - | - | - | - | - | - |
| Boron | µg/L | 0.03 | | 14.4 | 13.3 | 8% | 14.9 | 16.2 | 8% | 14.7 | 15.6 | 6% |
| Cadmium | µg/L | 0.002 | | 0.0027 | 0.0031 | - | <0.002 | <0.002 | - | <0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | | 0.0405 | 0.179 | - | 0.267 | 0.105 | - | 0.175 | 0.144 | - |
| Cobalt | µg/L | 0.001 | | 0.0102 | 0.0152 | **39%** | 0.0279 | 0.0214 | **26%** | 0.0126 | 0.0153 | 19% |
| Copper | µg/L | 0.05 | | 0.31 | 0.292 | 6% | 0.337 | 0.399 | 17% | 0.416 | 0.327 | **24%** |
| Iron | µg/L | 2 | | 20.3 | 19.2 | 6% | 27.2 | 14.4 | **62%** | 7.18 | 5.23 | - |
| Lead | µg/L | 0.001 | | 0.0037 | <0.001 | - | 0.0038 | 0.0106 | - | 0.0021 | <0.001 | - |
| Manganese | µg/L | 0.003 | | 3.68 | 1.74 | **72%** | 0.0712 | 0.0939 | **27%** | 0.213 | 0.21 | 1% |
| Molybdenum | µg/L | 0.6 | | 0.026 | 0.0121 | - | 0.0411 | 0.0425 | - | 0.0347 | 0.0438 | - |
| Nickel | µg/L | 0.001 | | 0.118 | 0.152 | **25%** | 0.273 | 0.367 | **29%** | 0.105 | 0.139 | **28%** |
| Selenium | µg/L | 0.005 | | 0.327 | 0.389 | 17% | 0.363 | 0.449 | **21%** | 0.486 | 0.483 | 1% |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | - | <0.0005 | <0.0005 | - | <0.0005 | <0.0005 | - |
| Strontium | µg/L | 0.0005 | | 88.7 | 88.1 | 1% | 90.5 | 91.5 | 1% | 92 | 92 | 0% |
| Thallium | µg/L | 0.004 | | - | - | - | - | - | - | - | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | - | - | - | - | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | - | - | - | - | - | - |
| Uranium | µg/L | 0.0001 | | 0.0073 | 0.0075 | 3% | 0.008 | 0.0082 | 2% | 0.0071 | 0.0072 | 1% |
| Vanadium | µg/L | 0.005 | | <0.01 | 0.0368 | - | 0.0516 | 0.0351 | **38%** | 0.0686 | 0.048 | **35%** |
| Zinc | µg/L | 0.05 | | 0.448 | 0.613 | **31%** | 0.803 | 0.374 | **73%** | 0.542 | 0.425 | **24%** |
| **Radionuclides** | | | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | <0.005 | <0.005 | - | <0.005 | 0.007 | - | <0.005 | <0.005 | - |
| **Other** | | | | | | | | | | | | |
| Fluoride | mg/L | 0.01 | | 0.04 | 0.04 | - | 0.04 | 0.05 | - | 0.05 | 0.05 | - |
| Sulphide | mg/L | 0.001 | | <0.001 | <0.001 | - | <0.001 | <0.001 | - | <0.001 | <0.001 | - |

[a] Guidelines are explained in Appendix B1.

Values in bold indicate that samples and duplicates are greater than five times the MRV, and greater than 20% different. '-' indicates that samples and/or duplicates are not greater than five times the MRV.

## Table B2.3 Notable results for QA/QC field duplicate samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Windy Outflow Field Duplicate 22-Jun-08 | | | Windy Outflow Field Duplicate 17-Jul-08 | | | Windy Outflow Field Duplicate 19-Aug-08 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | sample | duplicate | RPD | sample | duplicate | RPD | sample | duplicate | RPD |
| **Physical** | | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 27.5 | 27.6 | 0% | 39.5 | 39.7 | 1% | 49.6 | 49.6 | 0% |
| Specific Conductivity | µs/cm | 0.1 | | 230 | 230 | 0% | 343 | 341 | 1% | 430 | 429 | 0% |
| Total Dissolved Solids | mg/L | 0.1 | | 118 | 123 | 4% | 167 | 168 | 1% | 212 | 212 | 0% |
| Total Suspended Solids | mg/L | 1 | | 1 | 1 | - | <1 | <1 | - | <1 | <1 | - |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 39.3 | 39.5 | 1% | 53.8 | 53.3 | 1% | 71.3 | 68.7 | 4% |
| True Color | TCU | 1 | | 18 | 17 | 6% | 3 | <1 | - | <1 | <1 | - |
| **Nutrients** | | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.007 | 0.006 | 15% | 0.011 | 0.003 | - | 0.008 | 0.007 | 13% |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.16 | 0.23 | **36%** | 0.17 | 0.16 | 6% | 0.13 | 0.13 | 0% |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.004 | 0.005 | - | 0.005 | 0.008 | - | 0.004 | 0.004 | - |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | 0.005 | - | <0.005 | 0.005 | - | <0.005 | 0.005 | - |
| Nitrite as N | mg/L | 0.001 | 0.06 | 0.001 | 0.002 | - | <0.001 | <0.001 | - | <0.001 | <0.001 | - |
| **Organics** | | | | | | - | | | - | | | - |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 2.6 | 3 | 14% | 1.7 | 1.5 | 13% | 1.8 | 1.8 | 0% |
| **Major Ions** | | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 33 | 34 | 3% | 48 | 48 | 0% | 60 | 60 | 0% |
| Calcium (total) | mg/L | 0.004 | | 7.04 | 6.56 | 7% | 9.24 | 9.27 | 0% | 12.1 | 12 | 1% |
| Chloride | mg/L | 0.3 | | 50.5 | 50.7 | 0% | 76.3 | 76.6 | 0% | 95.2 | 96.9 | 2% |
| Magnesium (total) | mg/L | 0.0001 | | 5.38 | 5.42 | 1% | 7.4 | 7.57 | 2% | 9.94 | 9.77 | 2% |
| Potassium (total) | µg/L | 2 | | 2250 | 2110 | 6% | 2920 | 2980 | 2% | 4010 | 3970 | 1% |
| Sodium (total) | µg/L | 2 | | 27800 | 25000 | 11% | 39800 | 41100 | 3% | 54900 | 54200 | 1% |
| Sulfate | mg/L | 3 | | 9 | 14 | - | 5 | 6 | - | 4 | 4 | - |
| **Total Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 159 | 162 | 2% | 112 | 48.8 | **79%** | 46.6 | 46.6 | 0% |
| Antimony | µg/L | 0.0005 | | 0.0355 | 0.0307 | 15% | 0.0492 | 0.048 | 2% | 0.064 | 0.061 | 5% |
| Arsenic | µg/L | 0.002 | 5 | 0.284 | 0.351 | **21%** | 0.456 | 0.451 | 1% | 0.757 | 0.732 | 3% |
| Barium | µg/L | 0.004 | | 3.01 | 2.92 | 3% | 3 | 2.15 | **33%** | 2.61 | 2.54 | 3% |
| Beryllium | µg/L | 0.003 | | 0.0052 | 0.0035 | - | 0.0039 | 0.0039 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | 0.0016 | 0.0013 | - | 0.0024 | 0.001 | - | 0.0037 | 0.0023 | - |
| Boron | µg/L | 0.03 | | 25.4 | 25.6 | 1% | 37.4 | 38.7 | 3% | 52.6 | 51.6 | 2% |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | 0.0035 | 0.0022 | - | <0.002 | 0.0038 | - | <0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.393 | 0.399 | 2% | 0.3 | 0.228 | **27%** | 0.31 | 0.301 | 3% |
| Cobalt | µg/L | 0.001 | | 0.0571 | 0.054 | 6% | 0.0574 | 0.0217 | **90%** | 0.018 | 0.019 | 5% |
| Copper | µg/L | 0.05 | 2 - 4 | 0.97 | 0.601 | **47%** | 0.916 | 0.78 | 16% | 0.832 | 0.776 | 7% |
| Iron | µg/L | 2 | 300 | 121 | 114 | 6% | 166 | 58.6 | **96%** | 44.4 | 47.9 | 8% |
| Lead | µg/L | 0.001 | 1 - 7 | 0.0723 | 0.0503 | **36%** | 0.157 | 0.027 | **141%** | 0.023 | 0.0181 | **24%** |
| Manganese | µg/L | 0.003 | | 1.88 | 1.89 | 1% | 5.13 | 1.35 | **117%** | 1.53 | 1.58 | 3% |
| Mercury | ng/L | 0.6 | 26 | 1.4 | 1.1 | - | <0.6 | <0.6 | - | <0.6 | <0.6 | - |
| Molybdenum | µg/L | 0.001 | 73 | 0.346 | 0.322 | 7% | 0.498 | 0.49 | 2% | 0.674 | 0.651 | 3% |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.373 | 0.359 | 4% | 0.219 | 0.184 | 17% | 0.005 | <0.005 | - |
| Selenium | µg/L | 0.1 | 1 | 0.571 | 0.657 | 14% | 0.298 | 0.206 | - | 2.16 | 2.07 | 4% |
| Silver | µg/L | 0.0005 | 0.1 | 0.0011 | 0.0137 | - | 0.0006 | <0.0005 | - | 0.0036 | 0.0022 | - |
| Strontium | µg/L | 0.004 | | 32.7 | 32 | 2% | 46.5 | 46.8 | 1% | 61.4 | 60.7 | 1% |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0027 | 0.0029 | 7% | 0.004 | 0.0029 | **32%** | 0.0069 | 0.0057 | 19% |
| Tin | µg/L | 0.03 | | <0.03 | 0.068 | - | 0.967 | 0.03 | - | <0.03 | 0.03 | - |
| Uranium | µg/L | 0.0001 | | 0.0993 | 0.0997 | 0% | 0.105 | 0.111 | 6% | 0.202 | 0.201 | 0% |
| Vanadium | µg/L | 0.005 | | 0.259 | 0.28 | 8% | 0.173 | 0.0842 | **69%** | 0.023 | <0.01 | - |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 0.759 | 0.545 | **33%** | 0.86 | 0.574 | **40%** | 0.22 | 0.2 | - |
| **Dissolved Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | 39.4 | 37 | 6% | 3.85 | 4.62 | 18% | 8.33 | 8.21 | 1% |
| Antimony | µg/L | 0.0005 | | 0.0351 | 0.0304 | 14% | 0.0487 | 0.0475 | 2% | 0.0634 | 0.0604 | 5% |
| Arsenic | µg/L | 0.002 | | 0.261 | 0.298 | 13% | 0.344 | 0.384 | 11% | 0.653 | 0.728 | 11% |
| Barium | µg/L | 0.004 | | 1.62 | 1.56 | 4% | 1.7 | 1.66 | 2% | 2.07 | 2.03 | 2% |
| Beryllium | µg/L | 0.003 | | 0.0034 | <0.003 | - | <0.003 | <0.003 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | - | - | - | - | - | - | - | - | - |
| Boron | µg/L | 0.03 | | 23.2 | 24.2 | 4% | 34.6 | 36.5 | 5% | 50.1 | 49.1 | 2% |
| Cadmium | µg/L | 0.002 | | 0.0026 | 0.0021 | - | <0.002 | 0.0021 | - | <0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | | 0.325 | 0.38 | 16% | 0.164 | 0.191 | 15% | 0.307 | 0.298 | 3% |
| Cobalt | µg/L | 0.001 | | 0.0258 | 0.0223 | 15% | 0.0043 | 0.0039 | - | 0.0138 | 0.0119 | 15% |
| Copper | µg/L | 0.05 | | 0.96 | 0.595 | **47%** | 0.701 | 0.63 | 11% | 0.824 | 0.768 | 7% |
| Iron | µg/L | 2 | | 29.3 | 26.5 | 10% | 8.65 | 7.56 | - | 9.6 | 10 | - |
| Lead | µg/L | 0.001 | | 0.0212 | 0.0216 | 2% | 0.0074 | 0.0047 | - | 0.0081 | 0.0096 | 17% |
| Manganese | µg/L | 0.003 | | 0.29 | 0.341 | 16% | 0.303 | 0.354 | 16% | 0.283 | 0.282 | 0% |
| Molybdenum | µg/L | 0.6 | | 0.31 | 0.319 | - | 0.46 | 0.457 | - | 0.661 | 0.632 | - |
| Nickel | µg/L | 0.001 | | 0.253 | 0.355 | **34%** | 0.16 | 0.104 | **42%** | 0.005 | <0.005 | - |
| Selenium | µg/L | 0.005 | | 0.481 | 0.454 | 6% | <0.1 | 0.206 | - | 1.78 | 1.98 | 11% |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | - | <0.0005 | <0.0005 | - | 0.001 | <0.0005 | - |
| Strontium | µg/L | 0.0005 | | 30.9 | 31.7 | 3% | 43.5 | 44.4 | 2% | 58.5 | 57.9 | 1% |
| Thallium | µg/L | 0.004 | | - | - | - | - | - | - | - | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | - | - | - | - | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | - | - | - | - | - | - |
| Uranium | µg/L | 0.0001 | | 0.0814 | 0.0902 | 10% | 0.0801 | 0.0967 | 19% | 0.18 | 0.181 | 1% |
| Vanadium | µg/L | 0.005 | | 0.131 | 0.113 | 15% | <0.01 | 0.026 | - | 0.023 | <0.01 | - |
| Zinc | µg/L | 0.05 | | 0.751 | 0.54 | **33%** | 0.464 | 0.302 | **42%** | 0.218 | 0.198 | - |
| **Radionuclides** | | | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | <0.005 | <0.005 | - | <0.005 | <0.005 | - | 0.008 | <0.005 | - |
| **Other** | | | | | | | | | | | | |
| Fluoride | mg/L | 0.01 | | 0.04 | 0.05 | - | 0.07 | 0.07 | 0% | 0.08 | 0.08 | 0% |
| Sulphide | mg/L | 0.001 | | <0.001 | <0.001 | - | <0.001 | <0.001 | - | <0.001 | <0.001 | - |

[a] Guidelines are explained in Appendix B1.
Values in bold indicate that samples and duplicates are greater than five times the MRV, and greater than 20% different. '-' indicates that samples and/or duplicates are not greater than five times the MRV.

## Table B2.3 Notable results for QA/QC field duplicate samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Windy Outflow Field Duplicate 14-Sep-08 | | | Doris Lake Field Duplicate 24-May-08 | | | Doris Lake Field Duplicate 16-Jul-08 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | sample | duplicate | RPD | field | duplicate | RPD | field | duplicate | RPD |
| **Physical** | | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 48.7 | 48.8 | 0% | 35.2 | 35.2 | 0% | 29.9 | 30.2 | 1% |
| Specific Conductivity | µs/cm | 0.1 | | 434 | 434 | 0% | 321 | 326 | 2% | 300 | 299 | 0% |
| Total Dissolved Solids | mg/L | 0.1 | | 210 | 210 | 0% | 176.0 | 174 | 1% | 144.0 | 143 | 1% |
| Total Suspended Solids | mg/L | 1 | | <1 | <1 | - | 1 | 2 | - | 3 | 3 | - |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 73 | 73.8 | 1% | 56.3 | 55.7 | 1% | 50.4 | 49.2 | 2% |
| True Color | TCU | 1 | | 10 | 10 | 0% | 15 | 15 | 0% | 14 | 15 | 7% |
| **Nutrients** | | | | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 0.007 | 0.007 | 0% | 26 | 27 | 4% | 25 | 34 | **31%** |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.12 | 0.11 | 9% | 0.56 | 0.58 | 4% | 0.47 | 0.48 | 2% |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.006 | 0.004 | - | 0.007 | 0.004 | - | 0.005 | 0.011 | - |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | 0.005 | - | 0.015 | 0.006 | - | 0.014 | 0.014 | - |
| Nitrite as N | mg/L | 0.001 | 0.06 | <0.001 | 0.001 | - | 0.002 | 0.002 | - | <0.001 | <0.001 | - |
| **Organics** | | | | | | - | | | - | | | - |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 2 | 2.1 | 5% | 5.8 | 6.4 | 10% | 6.8 | 6.6 | 3% |
| **Major Ions** | | | | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 59 | 60 | 2% | 43 | 43 | 0% | 36 | 37 | 3% |
| Calcium (total) | mg/L | 0.004 | | 11.7 | 11.3 | 3% | 8.47 | 8.94 | 5% | 7.82 | 7.87 | 1% |
| Chloride | mg/L | 0.3 | | 95.8 | 94.8 | 1% | 83.1 | 82 | 1% | 70.3 | 69.6 | 1% |
| Magnesium (total) | mg/L | 0.0001 | | 10.1 | 9.72 | 4% | 6.84 | 8.43 | **21%** | 6.78 | 7 | 3% |
| Potassium (total) | µg/L | 2 | | 4040 | 3910 | 3% | 2570 | 2790 | 8% | 2520 | 2560 | 2% |
| Sodium (total) | µg/L | 2 | | 56400 | 54400 | 4% | 32500 | 40500 | **22%** | 33800 | 35000 | 3% |
| Sulfate | mg/L | 3 | | 4 | 6 | - | 6 | 5 | - | <3 | <3 | - |
| **Total Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 57.9 | 40 | **37%** | 7.1 | 7.08 | 0% | 52.5 | 54.1 | 3% |
| Antimony | µg/L | 0.0005 | | 0.124 | 0.0648 | **63%** | 0.115 | 0.146 | **24%** | 0.015 | 0.0154 | 0% |
| Arsenic | µg/L | 0.002 | 5 | 0.658 | 0.623 | 5% | 0.599 | 0.609 | 2% | 0.515 | 0.497 | 4% |
| Barium | µg/L | 0.004 | | 3.11 | 2.61 | 17% | 3.06 | 3.32 | 8% | 3.74 | 3.68 | 2% |
| Beryllium | µg/L | 0.003 | | 0.0049 | <0.003 | - | <0.003 | <0.003 | - | 0.004 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | 0.0072 | 0.0016 | - | <0.001 | 0.0018 | - | <0.001 | <0.001 | - |
| Boron | µg/L | 0.03 | | 48.5 | 46.4 | 4% | 29.30 | 28.7 | 2% | 23.90 | 24.9 | 4% |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | 0.0357 | 0.0047 | - | <0.002 | <0.002 | - | 0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.347 | 0.252 | **32%** | 0.22 | 0.207 | 8% | 0.25 | 0.228 | 8% |
| Cobalt | µg/L | 0.001 | | 0.0276 | 0.0216 | **24%** | 0.025 | 0.0211 | 18% | 0.062 | 0.0613 | 0% |
| Copper | µg/L | 0.05 | 2 - 4 | 1.04 | 0.903 | 14% | 1.19 | 1.39 | 16% | 1.66 | 1.61 | 3% |
| Iron | µg/L | 2 | 300 | 49.1 | 29.6 | **50%** | 14.6 | 7.93 | - | 216 | 217 | 0% |
| Lead | µg/L | 0.001 | 1 - 7 | 0.247 | 0.0846 | **98%** | <0.001 | <0.001 | - | 0.056 | 0.0475 | 17% |
| Manganese | µg/L | 0.003 | | 2.81 | 1.82 | **43%** | 3.8 | 3.47 | 9% | 50.5 | 50.7 | 0% |
| Mercury | ng/L | 0.6 | 26 | <0.6 | <0.6 | - | <0.6 | <0.6 | - | <0.6 | 1.7 | - |
| Molybdenum | µg/L | 0.001 | 73 | 0.656 | 0.611 | 7% | 0.155 | 0.158 | 2% | 0.144 | 0.137 | 5% |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.174 | 0.12 | **37%** | 0.370 | 0.349 | 6% | 0.452 | 0.456 | 1% |
| Selenium | µg/L | 0.1 | 1 | 1.34 | 1.5 | 11% | 0.3 | 0.165 | - | <0.1 | <0.1 | - |
| Silver | µg/L | 0.0005 | 0.1 | 0.0032 | 0.0033 | 3% | 0.0034 | 0.0016 | - | 0.0681 | 0.0011 | - |
| Strontium | µg/L | 0.004 | | 59.2 | 57 | 4% | 48.0 | 50.1 | 4% | 42.7 | 42.8 | 0% |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0042 | 0.0035 | 18% | 0.0005 | <0.0003 | - | 0.0015 | 0.0024 | - |
| Tin | µg/L | 0.03 | | <0.03 | 0.0495 | - | 0.98 | 1.16 | 17% | <0.03 | 0.03 | - |
| Uranium | µg/L | 0.0001 | | 0.198 | 0.189 | 5% | 0.0388 | 0.0345 | 12% | 0.0339 | 0.0338 | 0% |
| Vanadium | µg/L | 0.005 | | 0.0551 | 0.044 | **22%** | <0.01 | <0.01 | - | 0.129 | 0.103 | **22%** |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 3.9 | 1.24 | **104%** | <0.1 | <0.1 | - | 0.67 | 0.615 | 9% |
| **Dissolved Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | 6.65 | 5.07 | **27%** | 0.7 | 0.907 | - | 5.8 | 5.91 | 2% |
| Antimony | µg/L | 0.0005 | | 0.123 | 0.0642 | **63%** | 0.114 | 0.145 | **24%** | 0.015 | 0.0152 | 0% |
| Arsenic | µg/L | 0.002 | | 0.545 | 0.571 | 5% | 0.586 | 0.562 | 4% | 0.452 | 0.4 | 12% |
| Barium | µg/L | 0.004 | | 2.17 | 2 | 8% | 2.74 | 2.94 | 7% | 2.87 | 2.85 | 1% |
| Beryllium | µg/L | 0.003 | | 0.0047 | <0.003 | - | <0.003 | <0.003 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | - | - | - | | - | - | | - | - |
| Boron | µg/L | 0.03 | | 44.4 | 44.2 | 0% | 26.60 | 27.4 | 3% | 22.80 | 23.1 | 1% |
| Cadmium | µg/L | 0.002 | | 0.0252 | 0.0047 | - | <0.002 | <0.002 | - | 0.002 | <0.002 | - |
| Chromium | µg/L | 0.03 | | 0.344 | 0.249 | **32%** | 0.22 | 0.205 | 8% | 0.25 | 0.226 | 8% |
| Cobalt | µg/L | 0.001 | | 0.0068 | 0.0048 | - | 0.022 | 0.0186 | 18% | 0.018 | 0.0165 | 8% |
| Copper | µg/L | 0.05 | | 0.775 | 0.64 | 19% | 1.18 | 1.38 | 16% | 1.48 | 1.45 | 2% |
| Iron | µg/L | 2 | | <2 | <2 | - | 9.1 | <2 | - | 55.7 | 56.5 | 1% |
| Lead | µg/L | 0.001 | | 0.0205 | 0.0058 | **112%** | <0.001 | <0.001 | - | 0.011 | 0.0108 | 5% |
| Manganese | µg/L | 0.003 | | 0.41 | 0.206 | **66%** | 2.7 | 2.44 | 10% | 16.1 | 16.1 | 0% |
| Molybdenum | µg/L | 0.6 | | 0.632 | 0.605 | - | 0.153 | 0.155 | - | 0.140 | 0.135 | - |
| Nickel | µg/L | 0.001 | | 0.107 | 0.103 | 4% | 0.195 | 0.147 | **28%** | 0.263 | 0.307 | 15% |
| Selenium | µg/L | 0.005 | | 1.19 | 1.17 | 2% | 0.3 | 0.162 | **54%** | <0.1 | <0.1 | - |
| Silver | µg/L | 0.1 | | 0.0009 | 0.0007 | - | 0.0014 | <0.0005 | - | <0.0005 | <0.0005 | - |
| Strontium | µg/L | 0.0005 | | 54 | 53.8 | 0% | 47.2 | 48 | 2% | 41.7 | 40.9 | 2% |
| Thallium | µg/L | 0.004 | | - | - | - | | - | - | | - | - |
| Tin | µg/L | 0.0003 | | - | - | - | | - | - | | - | - |
| Titanium | µg/L | 0.03 | | - | - | - | | - | - | | - | - |
| Uranium | µg/L | 0.0001 | | 0.173 | 0.173 | 0% | 0.0294 | 0.0272 | 8% | 0.0268 | 0.0274 | 2% |
| Vanadium | µg/L | 0.005 | | 0.055 | 0.043 | **24%** | <0.01 | <0.01 | - | 0.080 | 0.054 | **39%** |
| Zinc | µg/L | 0.05 | | 2.45 | 0.931 | **90%** | <0.05 | <0.05 | - | 0.67 | 0.556 | 18% |
| **Radionuclides** | | | | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | <0.005 | <0.005 | - | | - | - | | <0.005 | - |
| **Other** | | | | | | | | | | | | |
| Fluoride | mg/L | 0.01 | | 0.09 | 0.08 | 12% | 0.07 | 0.07 | 0% | 0.06 | 0.05 | - |
| Sulphide | mg/L | 0.001 | | <0.001 | <0.001 | - | <0.001 | <0.001 | - | <0.001 | <0.001 | - |

[a] Guidelines are explained in Appendix B1.

Values in bold indicate that samples and duplicates are greater than five times the MRV, and greater than 20% different. '-' indicates that samples and/or duplicates are not greater than five times the MRV.

## Table B2.3 Notable results for QA/QC field duplicate samples, 2008.

| Parameter | Units | MRV | CWQG - Aquatic Life[a] | Doris Lake Field Duplicate 17-Aug-08 | | | Doris Lake Field Duplicate 11-Sep-08 / 12-Sep-08 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | field | duplicate | RPD | field | duplicate | RPD |
| **Physical** | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | 1 | | 27.0 | 27.1 | 0% | 27.3 | 27.4 | 0% |
| Specific Conductivity | µs/cm | 0.1 | | 265 | 266 | 0% | 267 | 267 | 0% |
| Total Dissolved Solids | mg/L | 0.1 | | 128.0 | 129 | 1% | 128.0 | 123 | 4% |
| Total Suspended Solids | mg/L | 1 | | 6 | 4 | - | 5 | 6 | - |
| Hardness (Total as $CaCO_3$) | mg/L | 0.01 | | 44.9 | 45.7 | 2% | 46.4 | 45.9 | 1% |
| True Color | TCU | 1 | | 12 | 12 | 0% | 22 | 15 | **38%** |
| **Nutrients** | | | | | | | | | |
| Total Phosphorus | mg/L | 0.001 | | 34 | 28 | 19% | 31 | 33 | 6% |
| Total Kjeldahl Nitrogen | mg/L | 0.01 | | 0.48 | 0.51 | 6% | 0.59 | 0.6 | 2% |
| Ammonia - N | mg/L | 0.001 | 0.2 - 122.4 | 0.011 | 0.04 | **114%** | 0.007 | 0.006 | 15% |
| Nitrite+Nitrate as N | mg/L | 0.005 | | <0.005 | <0.005 | - | <0.005 | <0.005 | - |
| Nitrite as N | mg/L | 0.001 | 0.06 | <0.001 | <0.001 | - | <0.001 | <0.001 | - |
| **Organics** | | | | | | - | | | - |
| Organic Carbon (dissolved) | mg/L | 0.2 | | 6.3 | 5.8 | 8% | 6.4 | 5.5 | 15% |
| **Major Ions** | | | | | | | | | |
| Bicarbonate | mg/L | 1 | | 33 | 33 | 0% | 33 | 33 | 0% |
| Calcium (total) | mg/L | 0.004 | | 7.31 | 7.33 | 0% | 7.51 | 7.66 | 2% |
| Chloride | mg/L | 0.3 | | 61.8 | 61.5 | 0% | 62.5 | 60.7 | 3% |
| Magnesium (total) | mg/L | 0.0001 | | 6.41 | 6.52 | 2% | 6.52 | 6.65 | 2% |
| Potassium (total) | µg/L | 2 | | 2390 | 2400 | 0% | 2320 | 2370 | 2% |
| Sodium (total) | µg/L | 2 | | 32700 | 33600 | 3% | 31600 | 32500 | 3% |
| Sulfate | mg/L | 3 | | <3 | 4 | - | <3 | <3 | - |
| **Total Metals** | | | | | | | | | |
| Aluminum | µg/L | 0.5 | 5, 100 | 68.3 | 67.1 | 2% | 71.2 | 50.1 | **35%** |
| Antimony | µg/L | 0.0005 | | 0.015 | 0.0154 | 3% | 0.014 | 0.0202 | **38%** |
| Arsenic | µg/L | 0.002 | 5 | 0.549 | 0.587 | 7% | 0.444 | 0.493 | 10% |
| Barium | µg/L | 0.004 | | 3.54 | 3.46 | 2% | 3.39 | 3.17 | 7% |
| Beryllium | µg/L | 0.003 | | 0.004 | <0.003 | - | 0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | 0.002 | <0.001 | - | <0.001 | 0.0056 | - |
| Boron | µg/L | 0.03 | | 22.50 | 23.9 | 6% | 22.00 | 22.5 | 2% |
| Cadmium | µg/L | 0.002 | 0.007 - 0.055 | 0.003 | 0.0024 | - | <0.002 | 0.0051 | - |
| Chromium | µg/L | 0.03 | 1 or 16 | 0.23 | 0.173 | **27%** | 0.27 | 0.294 | 10% |
| Cobalt | µg/L | 0.001 | | 0.038 | 0.0353 | 8% | 0.035 | 0.0416 | 17% |
| Copper | µg/L | 0.05 | 2 - 4 | 1.43 | 1.4 | 2% | 1.46 | 1.68 | 14% |
| Iron | µg/L | 2 | 300 | 90.9 | 82.5 | 10% | 74.8 | 74.2 | 1% |
| Lead | µg/L | 0.001 | 1 - 7 | 0.033 | 0.0243 | **31%** | 0.027 | 0.152 | **140%** |
| Manganese | µg/L | 0.003 | | 16.0 | 14.9 | 7% | 9.0 | 9.72 | 7% |
| Mercury | ng/L | 0.6 | 26 | 1.4 | 1.9 | - | 0.9 | 0.9 | - |
| Molybdenum | µg/L | 0.001 | 73 | 0.138 | 0.139 | 1% | 0.143 | 0.154 | 7% |
| Nickel | µg/L | 0.005 | 25 - 150 | 0.466 | 0.421 | 10% | 0.476 | 0.461 | 3% |
| Selenium | µg/L | 0.1 | 1 | 1.2 | 1.26 | 6% | 0.7 | 1.07 | **43%** |
| Silver | µg/L | 0.0005 | 0.1 | <0.0005 | <0.0005 | - | <0.0005 | <0.0005 | - |
| Strontium | µg/L | 0.004 | | 38.5 | 37.9 | 2% | 38.8 | 38.9 | 0% |
| Thallium | µg/L | 0.0003 | 0.8 | 0.0037 | 0.0032 | 14% | 0.0029 | 0.0048 | **49%** |
| Tin | µg/L | 0.03 | | <0.03 | 0.03 | - | <0.03 | 0.0668 | - |
| Uranium | µg/L | 0.0001 | | 0.0345 | 0.0328 | 5% | 0.0330 | 0.0339 | 3% |
| Vanadium | µg/L | 0.005 | | 0.116 | 0.095 | 20% | 0.153 | 0.16 | 4% |
| Zinc | µg/L | 0.1 | 30, 13 - 198 | 0.32 | 0.599 | - | 0.31 | <0.1 | - |
| **Dissolved Metals** | | | | | | | | | |
| Aluminum | µg/L | 0.2 | | 5.6 | 5.38 | 4% | 5.6 | 5.6 | 0% |
| Antimony | µg/L | 0.0005 | | 0.015 | 0.0152 | 2% | 0.014 | 0.02 | **38%** |
| Arsenic | µg/L | 0.002 | | 0.464 | 0.501 | 8% | 0.399 | 0.488 | **20%** |
| Barium | µg/L | 0.004 | | 2.49 | 2.51 | 1% | 2.37 | 2.49 | 5% |
| Beryllium | µg/L | 0.003 | | <0.003 | <0.003 | - | <0.003 | <0.003 | - |
| Bismuth | µg/L | 0.001 | | | - | - | | - | - |
| Boron | µg/L | 0.03 | | 20.80 | 22 | 6% | 19.90 | 21.5 | 8% |
| Cadmium | µg/L | 0.002 | | <0.002 | <0.002 | - | <0.002 | 0.0021 | - |
| Chromium | µg/L | 0.03 | | 0.22 | 0.171 | **23%** | 0.25 | 0.258 | 4% |
| Cobalt | µg/L | 0.001 | | 0.018 | 0.0165 | 9% | 0.017 | 0.0274 | **47%** |
| Copper | µg/L | 0.05 | | 1.42 | 1.39 | 2% | 1.45 | 1.66 | 14% |
| Iron | µg/L | 2 | | 9.1 | 5.31 | - | 9.3 | 12.1 | - |
| Lead | µg/L | 0.001 | | 0.008 | 0.0065 | 19% | <0.001 | 0.0189 | - |
| Manganese | µg/L | 0.003 | | 0.1 | 0.112 | **22%** | 0.1 | 0.159 | **51%** |
| Molybdenum | µg/L | 0.6 | | 0.131 | 0.132 | - | 0.131 | 0.139 | - |
| Nickel | µg/L | 0.001 | | 0.206 | 0.176 | 16% | 0.191 | 0.253 | **28%** |
| Selenium | µg/L | 0.005 | | 0.8 | 0.887 | 8% | 0.6 | 0.77 | **23%** |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | - | <0.0005 | <0.0005 | - |
| Strontium | µg/L | 0.0005 | | 37.3 | 37.1 | 1% | 36.4 | 38.5 | 6% |
| Thallium | µg/L | 0.004 | | | - | - | | - | - |
| Tin | µg/L | 0.0003 | | | - | - | | - | - |
| Titanium | µg/L | 0.03 | | | - | - | | - | - |
| Uranium | µg/L | 0.0001 | | 0.0282 | 0.0264 | 7% | 0.0266 | 0.0295 | 10% |
| Vanadium | µg/L | 0.005 | | 0.040 | 0.04 | 0% | 0.075 | 0.092 | **21%** |
| Zinc | µg/L | 0.05 | | 0.32 | 0.593 | **61%** | 0.08 | <0.05 | - |
| **Radionuclides** | | | | | | | | | |
| Radium-226 | Bq/L | 0.005 | | | <0.005 | - | | <0.005 | - |
| **Other** | | | | | | | | | |
| Fluoride | mg/L | 0.01 | | 0.07 | 0.06 | 15% | 0.07 | 0.06 | 15% |
| Sulphide | mg/L | 0.001 | | <0.001 | <0.001 | - | <0.001 | 0.001 | - |

[a] Guidelines are explained in Appendix B1.

Values in bold indicate that samples and duplicates are greater than five times the MRV, and greater than 20% different. '-' indicates that samples and/or duplicates are not greater than five times the MRV.

**Table B2.4 Notable results for marine QA/QC laboratory split sample, 2008.**

| Parameter | MRV | Units | Hope Bay Top Lab Split Sample | | |
|---|---|---|---|---|---|
| | | | 19-Aug-08 | | |
| | | | Split 1 | Split 2 | RPD |
| **Nutrients** | | | | | |
| Total Phosphorus | 0.005 | mg/L | 0.061 | 0.059 | 3% |
| **Major Ions** | | | | | |
| Calcium (dissolved) | 0.5 | mg/L | 285 | 78 | **114%** |
| Magnesium (dissolved) | 1 | mg/L | 752 | 227 | **107%** |
| Potassium (dissolved) | 0.001 | ug/L | 220 | 70 | **103%** |
| Sodium (dissolved) | 0.001 | ug/L | 6380 | 1880 | **109%** |
| **Dissolved Metals** | | | | | |
| Aluminum | 10 | ug/L | <10 | 35 | - |
| Antimony | 0.5 | ug/L | <0.5 | <0.5 | - |
| Arsenic | 0.5 | ug/L | 0.7 | <0.5 | - |
| Barium | 1 | ug/L | 7 | 3 | - |
| Beryllium | 1 | ug/L | <1 | <1 | - |
| Bismuth | 1 | ug/L | <1 | <1 | - |
| Boron | 50 | ug/L | 2160 | 770 | **95%** |
| Cadmium | 0.05 | ug/L | 0.05 | <0.05 | - |
| Chromium | 0.5 | ug/L | 0.8 | <0.5 | - |
| Cobalt | 0.1 | ug/L | <0.1 | <0.1 | - |
| Copper | 0.5 | ug/L | 1 | 1.3 | - |
| Iron | 2 | ug/L | 5 | 79 | - |
| Lead | 0.1 | ug/L | <0.1 | <0.1 | - |
| Manganese | 0.5 | ug/L | 1.1 | 4.1 | - |
| Molybdenum | 1 | ng/L | 6 | 2 | - |
| Nickel | 0.2 | ug/L | 0.6 | 0.5 | - |
| Selenium | 0.5 | ug/L | 0.8 | <0.5 | - |
| Silver | 0.05 | ug/L | <0.05 | <0.05 | - |
| Strontium | 10 | ug/L | 4150 | 1180 | **111%** |
| Thallium | 0.1 | ug/L | <0.1 | <0.1 | - |
| Tin | 1 | ug/L | <1 | <1 | - |
| Titanium | 10 | ug/L | <10 | <10 | - |
| Uranium | 0.05 | ug/L | 1.62 | 0.46 | **112%** |
| Vanadium | 10 | ug/L | <10 | <10 | - |
| Zinc | 1 | ug/L | 2 | <1 | - |
| **Other** | | | | | |
| Sulphur (dissolved) | 20 | mg/L | 598 | 199 | **100%** |

Values in bold indicate that samples and duplicates are greater than five times the MRV, and greater than 20% different. '-' indicates that samples and/or duplicates are not greater than five times the MRV.

# APPENDICES B3 AND B4

# FIELD MEASUREMENTS
# PHYSICAL LIMNOLOGY

# Appendix B3. Dissolved oxygen, pH, water temperature, field conductivity, secchi depth, and water depth, 2008.

| Waterbody | Date | Dissolved Oxygen (mg/L) | Field pH | Water Temperature (°C) | Field Conductivity (µs/cm) | Secchi Depth (m) | Water Depth (m) |
|---|---|---|---|---|---|---|---|
| **BOSTON PROJECT AREA** | | | | | | | |
| Aimaokatalok River | 6/24/2008 | 13.4 | 6.7 | 4.1 | 32 | | |
| | 7/19/2008 | 10.6 | 7.0 | 12.7 | 19 | | |
| | 8/15/2008 | 12.8 | 7.5 | 10.5 | 31 | | |
| | 9/15/2008 | 14.3 | 7.3 | 1.1 | 43 | | |
| Aimaokatalok Inflow | 6/24/2008 | 12.5 | 6.6 | 4.8 | 52 | | |
| | 7/19/2008 | 10.6 | 7.3 | 12.8 | 60 | | |
| | 8/13/2008 | 12.4 | 7.2 | 11.9 | 67 | | |
| | 9/8/2008 | 14.2 | 8.4 | 3.5 | 139 | | |
| Aimaokatalok Lake Site 4 | 5/22/2008 | 10.6 | 6.9 | 0.4 | 70 | nd | 5.1 |
| | 7/19/2008 | 12.0 | 6.9 | 8.8 | 27 | 2.0 | 8.0 |
| | 8/14/2008 | 11.8 | 7.2 | 11.5 | 61 | 2.6 | 7.2 |
| | 9/8/2008 | 13.1 | 7.4 | 6.5 | 43 | 2.6 | 7.2 |
| Aimaokatalok Lake Site 6 | 5/22/2008 | 10.4 | 6.8 | 0.1 | 68 | nd | 26.5 |
| | 7/19/2008 | 10.6 | 6.7 | 14.1 | 28 | 2.0 | 28.3 |
| | 8/14/2008 | 11.8 | 7.4 | 11.7 | 60 | 2.5 | 27.9 |
| | 9/8/2008 | 13.1 | 7.3 | 6.6 | 64 | 2.2 | 28.7 |
| Aimaokatalok Outflow | 6/24/2008 | 12.9 | 6.6 | 3.0 | 58 | | |
| | 7/19/2008 | 12.1 | 6.8 | 6.1 | 28 | | |
| | 8/13/2008 | 11.8 | 7.4 | 12.3 | 39 | | |
| | 9/15/2008 | 12.5 | 7.0 | 3.8 | 49 | | |
| Fickle Duck Lake | 7/18/2008 | 10.9 | 7.5 | 13.3 | 36 | 1.5 | 2.6 |
| | 8/14/2008 | 11.8 | 7.6 | 11.5 | 70 | 1.3 | 2.8 |
| | 9/9/2008 | 13.8 | 7.7 | 4.1 | 67 | 1.5 | 3.4 |
| Fickle Duck Outflow | 6/26/2008 | 11.4 | 6.4 | 3.4 | 47 | | |
| | 7/18/2008 | 8.1 | 6.9 | 11.7 | 42 | | |
| | 8/14/2008 | 11.5 | 7.3 | | 71 | | |
| | 9/15/2008 | 13.0 | 7.3 | 1.8 | 90 | | |
| Reference Lake | 7/18/2008 | 10.9 | 7.5 | 13.0 | 21 | 1.5 | 3.7 |
| | 8/15/2008 | 11.6 | 7.5 | 11.5 | 42 | 2.5 | 4.3 |
| | 9/9/2008 | 13.7 | 7.7 | 4.6 | 54 | 3.5 | 4.5 |
| Reference Outflow | 6/24/2008 | 12.1 | 6.7 | 5.4 | 35 | | |
| | 7/18/2008 | 9.6 | 7.0 | 10.9 | 23 | | |
| | 8/15/2008 | 12.1 | 7.5 | 11.9 | 38 | | |
| | 9/9/2008 | 13.4 | 7.1 | 2.7 | 54 | | |
| Stickleback Lake | 7/18/2008 | 12.3 | 7.7 | 10.9 | 188 | Bottom | 3.0 |
| | 8/14/2008 | 12.0 | 7.9 | 12.0 | 236 | Bottom | 3.1 |
| | 9/9/2008 | 14.0 | 7.7 | 4.1 | 229 | Bottom | 3.0 |
| Stickleback Outflow | 6/26/2008 | 11.7 | 6.7 | 2.6 | 88 | | |
| | 7/18/2008 | 8.4 | 7.4 | 10.7 | 190 | | |
| | 8/14/2008 | | 7.4 | 11.5 | 226 | | |
| | 9/9/2008 | 13.6 | 7.9 | 4.4 | 221 | | |
| **DORIS PROJECT AREA** | | | | | | | |
| Doris Lake | 5/24/2008 | 12.7 | 6.1 | 0.0 | 338 | nd | 13.0 |
| | 7/16/2008 | 11.4 | 7.0 | 5.8 | 255 | 1.3 | 15.5 |
| | 8/17/2008 | 10.8 | 8.0 | 10.8 | 248 | 1.0 | 15.2 |
| | 9/11/2008 | 13.2 | 8.0 | 6.3 | 248 | 0.9 | 13.5 |
| Doris Outflow | 6/22/2008 | 13.2 | 7.0 | 3.6 | 256 | | |
| | 7/17/2008 | 12.6 | 7.6 | 6.8 | 259 | | |
| | 8/14/2008 | 12.6 | 8.0 | 10.5 | 250 | | |
| | 9/12/2008 | 14.2 | 7.5 | 4.7 | 247 | | |
| Little Roberts Lake | 5/25/2008 | 9.8 | 6.4 | 0.0 | 573 | nd | 2.9 |
| | 7/14/2008 | 12.2 | 7.3 | 6.3 | 213 | 1.4 | 2.8 |
| | 8/18/2008 | 12.5 | 7.7 | 9.4 | 242 | 1.5 | 2.5 |
| | 9/12/2008 | 14.0 | 7.8 | 4.1 | 251 | 1.0 | 2.7 |
| Little Roberts Outflow | 6/19/2008 | 12.5 | 6.8 | 3.8 | 250 | | |
| | 7/17/2008 | 12.4 | 7.7 | 9.5 | 234 | | |
| | 8/14/2008 | 12.8 | 7.8 | 10.1 | 251 | | |
| | 9/12/2008 | 14.0 | 7.8 | 4.1 | 251 | | |
| Roberts Lake | 5/25/2008 | 9.2 | 9.2 | 0.1 | 229 | nd | 4.8 |
| | 7/15/2008 | 12.2 | 7.5 | 8.0 | 178 | 1.4 | 5.2 |
| | 8/18/2008 | 13.0 | 7.9 | 9.0 | 228 | 2.4 | 5.0 |
| | 9/12/2008 | 13.9 | 7.8 | 4.7 | 249 | 1.2 | 5.5 |
| Roberts Outflow | 6/19/2008 | 12.5 | 8.6 | 2.6 | 186 | | |
| | 7/17/2008 | 12.7 | 7.5 | 7.4 | 186 | | |
| | 8/14/2008 | 12.9 | 8.0 | 9.9 | 226 | | |
| | 9/12/2008 | 13.1 | 8.1 | 3.5 | 254 | | |
| Tail Lake | 5/24/2008 | 9.9 | 7.2 | 0.0 | 276 | nd | 3.9 |
| | 7/14/2008 | 11.8 | 7.5 | 8.6 | 112 | 2.5 | 4.9 |
| | 8/18/2008 | 12.1 | 7.9 | 10.1 | 132 | 3.9 | 5.6 |
| | 9/11/2008 | 13.8 | 7.8 | 3.5 | 129 | 2.9 | 5.6 |
| Tail Outflow | 6/22/2008 | 11.3 | 7.0 | 6.5 | 203 | | |
| | 7/17/2008 | 7.9 | 7.1 | 12.6 | 122 | | |
| | 8/14/2008 | 10.0 | 7.1 | 9.5 | 148 | | |
| | 9/12/2008 | 13.3 | 7.2 | 2.8 | 38 | | |

# Appendix B3. Dissolved oxygen, pH, water temperature, field conductivity, secchi depth, and water depth, 2008.

| Waterbody | Date | Dissolved Oxygen (mg/L) | Field pH | Water Temperature (°C) | Field Conductivity (µs/cm) | Secchi Depth (m) | Water Depth (m) |
|---|---|---|---|---|---|---|---|
| **MADRID PROJECT AREA** | | | | | | | |
| Glenn Lake | 7/15/2008 | 14.0 | 7.6 | 3.9 | 307 | 1.6 | 19.7 |
| | 8/18/2008 | 12.5 | 8.2 | 10.0 | 352 | 0.8 | 19.6 |
| | 9/13/2008 | 12.2 | 8.5 | 5.6 | 395 | 0.5 | 19.8 |
| Glenn Outflow | 6/20/2008 | 13.2 | 6.8 | 2.6 | 226 | | |
| | 7/17/2008 | 12.7 | 7.8 | 7.4 | 291 | | |
| | 8/19/2008 | 12.6 | 8.1 | 8.5 | 355 | | |
| | 9/13/2008 | 12.4 | 8.3 | 5.3 | 462 | | |
| Koignuk River | 6/23/2008 | 14.8 | 7.1 | 3.5 | 70 | | |
| | 7/17/2008 | 11.6 | 7.3 | 12.2 | 39 | | |
| | 8/19/2008 | 13.3 | 7.8 | 6.5 | 61 | | |
| | 9/14/2008 | 13.4 | 8.0 | 2.3 | 55 | | |
| Ogama Lake | 5/24/2008 | 8.9 | 6.9 | 0.0 | 697 | nd | 6.5 |
| | 7/15/2008 | 11.7 | 7.5 | 9.6 | 155 | 5.9 | 7.0 |
| | 8/17/2008 | 12.5 | 8.0 | 11.3 | 210 | 1.2 | 6.0 |
| | 9/10/2008 | 13.7 | 7.9 | 4.4 | 212 | 0.6 | 8.0 |
| Ogama Outflow | 6/23/2008 | 11.3 | 6.8 | 3.1 | 211 | | |
| | 7/17/2008 | 11.5 | 7.5 | 11.5 | 162 | | |
| | 8/19/2008 | 12.7 | 8.0 | 8.3 | 218 | | |
| | 9/14/2008 | 13.4 | 8.3 | 2.2 | 224 | | |
| Patch Lake | 5/23/2008 | 13.9 | 6.6 | 0.0 | 476 | nd | 12.5 |
| | 7/17/2008 | 12.1 | 7.7 | 10.2 | 227 | 2.0 | 13.8 |
| | 8/15/2008 | 12.0 | 8.0 | 12.2 | 311 | 2.8 | 13.8 |
| | 9/10/2008 | 13.5 | 7.9 | 5.0 | 324 | 1.2 | 13.9 |
| Patch Outflow | 6/21/2008 | 12.5 | 7.0 | 2.6 | 160 | | |
| | 7/17/2008 | 11.6 | 7.6 | 10.4 | 270 | | |
| | 8/19/2008 | 12.8 | 8.2 | 8.7 | 354 | | |
| | 9/10/2008 | 13.8 | 8.0 | 4.9 | 320 | | |
| Pelvic Lake | 7/15/2008 | 12.0 | 7.3 | 8.2 | 168 | 0.8 | 15.0 |
| | 8/16/2008 | 12.3 | 8.0 | 11.8 | 212 | 1.0 | 16.0 |
| | 9/11/2008 | 13.5 | 7.6 | 5.4 | 210 | 0.5 | 17.5 |
| Pelvic Outflow | 6/21/2008 | 12.5 | 7.1 | 3.0 | 82 | | |
| | 7/17/2008 | 12.0 | 7.4 | 9.8 | 182 | | |
| | 8/19/2008 | 13.2 | 8.7 | 8.3 | 216 | | |
| | 9/11/2008 | 14.0 | 7.8 | 4.8 | 209 | | |
| P.O. Lake | 7/14/2008 | 12.2 | 7.7 | 9.5 | 179 | 1.7 | 3.5 |
| | 8/17/2008 | 12.4 | 7.8 | 11.2 | 270 | 1.0 | 2.9 |
| | 9/10/2008 | 13.6 | 7.9 | 4.4 | 280 | 0.4 | 4.1 |
| P.O. Outflow | 6/21/2008 | 12.2 | 7.4 | 2.2 | 277 | | |
| | 7/17/2008 | 11.9 | 7.6 | 12.1 | 191 | | |
| | 8/19/2008 | 12.9 | 8.1 | 7.7 | 282 | | |
| | 9/10/2008 | 13.9 | 7.9 | 4.5 | 290 | | |
| Windy Lake | 5/24/2008 | 15.2 | 7.4 | 0.0 | 472 | nd | 17.0 |
| | 7/20/2008 | 14.9 | 7.7 | 4.9 | 359 | 3.0 | 18.7 |
| | 8/19/2008 | 13.0 | 8.4 | 9.2 | 418 | 3.5 | 18.7 |
| | 9/14/2008 | 12.2 | 8.1 | 5.6 | 444 | 3.0 | 18.2 |
| Windy Outflow | 6/22/2008 | 13.3 | 7.5 | 4.5 | 204 | | |
| | 7/17/2008 | 12.6 | 7.5 | 6.1 | 274 | | |
| | 8/19/2008 | 11.4 | 8.0 | 6.7 | 403 | | |
| | 9/10/2008 | 13.0 | 8.4 | 3.7 | - | | |
| Wolverine Lake | 5/23/2008 | 8.9 | 6.7 | 0.0 | 1630 | nd | 2.2 |
| | 7/14/2008 | 11.8 | 7.8 | 9.5 | 251 | Bottom | 2.3 |
| | 8/15/2008 | 12.5 | 8.3 | 11.8 | 322 | Bottom | 2.3 |
| | 9/10/2008 | 13.8 | 7.9 | 4.3 | 333 | Bottom | 2.5 |
| **MARINE BAYS** | | | | | | | |
| Hope Bay | 7/16/2008 | 12.2 | 7.6 | 9.8 | 1730 | 2.0 | 11.8 |
| | 8/19/2008 | 13.1 | 7.9 | 8.9 | > 3999 | 2.0 | 15.5 |
| | 9/13/2008 | 13.0 | 8.1 | 4.7 | > 3999 | 5.0 | 16.2 |
| Roberts Bay | 7/16/2008 | 12.8 | 7.4 | 8.4 | 3750 | 1.8 | 4.3 |
| | 8/19/2008 | 13.2 | 8.0 | 7.7 | > 3999 | 2.1 | 4.2 |
| | 9/13/2008 | 12.9 | 8.1 | 4.3 | > 3999 | 3.4 | 4.2 |

**Appendix B4. Dissolved oxygen and water temperature profiles, 2008.**

## BOSTON PROJECT AREA

### AIMAOKATALOK LAKE (SITE 4) (13W 438988E 7508924N NAD83)

| 19 July 2008 | | | 14 August 2008 | | | 8 September 2008 | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.0 | 8.8 | 0.0 | 11.84 | 11.5 | 0.0 | 13.13 | 6.5 |
| 0.5 | 11.9 | 7.7 | 1.0 | 11.83 | 11.6 | 1.0 | 13.04 | 6.7 |
| 1.0 | 11.8 | 7.4 | 2.0 | 11.82 | 11.6 | 2.0 | 12.96 | 6.8 |
| 1.5 | 11.9 | 7.2 | 3.0 | 11.82 | 11.6 | 3.0 | 12.93 | 6.8 |
| 2.0 | 12.0 | 6.9 | 4.0 | 11.80 | 11.6 | 4.0 | 12.91 | 6.9 |
| 2.5 | 12.0 | 6.9 | 5.0 | 11.80 | 11.6 | 5.0 | 12.91 | 6.9 |
| 3.0 | 12.0 | 6.8 | 6.0 | 11.82 | 11.6 | 6.0 | 12.90 | 6.9 |
| 3.5 | 12.0 | 7.0 | 7.0 | 11.72 | 11.6 | 6.5 | 12.75 | 7.0 |
| 4.0 | 11.9 | 6.4 | | | | | | |
| 4.5 | 11.9 | 6.1 | | | | | | |
| 5.0 | 11.9 | 5.6 | | | | | | |
| 5.5 | 12.0 | 5.4 | | | | | | |
| 6.0 | 12.0 | 5.4 | | | | | | |
| 6.5 | 12.0 | 5.3 | | | | | | |
| 7.0 | 12.0 | 5.3 | | | | | | |
| 7.5 | 12.0 | 5.3 | | | | | | |

### AIMAOKATALOK LAKE (SITE 6) (13W 440429E 7509045N NAD83)

| 19 July 2008 | | | 14 August 2008 | | | 8 September 2008 | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 10.6 | 14.1 | 0.0 | 11.81 | 11.7 | 0.0 | 13.07 | 6.6 |
| 1.0 | 11.5 | 7.3 | 1.0 | 11.81 | 11.7 | 1.0 | 13.08 | 6.6 |
| 2.0 | 11.7 | 6.9 | 2.0 | 11.79 | 11.8 | 2.0 | 13.03 | 6.6 |
| 3.0 | 11.8 | 6.6 | 3.0 | 11.78 | 11.8 | 3.0 | 13.02 | 6.7 |
| 4.0 | 11.8 | 6.5 | 4.0 | 11.78 | 11.8 | 4.0 | 13.00 | 6.7 |
| 5.0 | 11.8 | 6.4 | 5.0 | 11.78 | 11.8 | 5.0 | 12.99 | 6.7 |
| 6.0 | 11.8 | 6.2 | 6.0 | 11.77 | 11.8 | 6.0 | 13.02 | 6.6 |
| 7.0 | 11.8 | 6.1 | 7.0 | 11.77 | 11.8 | 7.0 | 13.01 | 6.7 |
| 8.0 | 11.9 | 6.1 | 8.0 | 11.79 | 11.8 | 8.0 | 13.01 | 6.7 |
| 9.0 | 11.9 | 6.0 | 9.0 | 11.78 | 11.8 | 9.0 | 13.01 | 6.7 |
| 10.0 | 11.9 | 5.9 | 10.0 | 11.79 | 11.8 | 10.0 | 13.01 | 6.7 |
| 11.0 | 11.9 | 5.8 | 11.0 | 11.76 | 11.8 | 11.0 | 13.01 | 6.6 |
| 12.0 | 11.9 | 5.8 | 12.0 | 11.76 | 11.8 | 12.0 | 13.02 | 6.6 |
| 13.0 | 11.9 | 5.7 | 13.0 | 11.76 | 11.8 | 13.0 | 13.01 | 6.6 |
| 14.0 | 11.9 | 5.7 | 14.0 | 11.77 | 11.8 | 14.0 | 13.02 | 6.6 |
| 15.0 | 11.9 | 5.7 | 15.0 | 11.76 | 11.8 | 15.0 | 12.97 | 6.6 |
| 16.0 | 11.9 | 5.7 | 16.0 | 11.75 | 11.8 | 16.0 | 12.97 | 6.6 |
| 17.0 | 11.9 | 5.7 | 17.0 | 11.75 | 11.8 | 17.0 | 12.98 | 6.6 |
| 18.0 | 11.9 | 5.7 | 18.0 | 11.75 | 11.8 | 18.0 | 12.97 | 6.6 |
| 19.0 | 11.9 | 5.7 | 19.0 | 11.72 | 11.7 | 19.0 | 12.99 | 6.6 |
| 20.0 | 11.9 | 5.7 | 20.0 | 11.72 | 11.7 | 20.0 | 12.99 | 6.6 |
| 21.0 | 11.9 | 5.6 | 21.0 | 11.70 | 11.7 | 21.0 | 12.97 | 6.6 |
| 22.0 | 11.9 | 5.6 | 22.0 | 11.69 | 11.7 | 22.0 | 12.99 | 6.6 |
| 23.0 | 11.9 | 5.6 | 23.0 | 11.69 | 11.7 | 23.0 | 12.94 | 6.4 |
| 24.0 | 12.0 | 5.5 | 24.0 | 11.68 | 11.7 | 24.0 | 12.97 | 6.6 |
| 25.0 | 11.9 | 5.5 | 25.0 | 11.64 | 11.7 | 25.0 | 12.98 | 6.6 |
| 26.0 | 12.0 | 5.5 | 26.0 | 11.62 | 11.6 | 26.0 | 12.99 | 6.6 |
| 27.0 | 12.0 | 5.4 | 27.0 | 11.63 | 11.6 | 27.0 | 13.04 | 6.6 |
| | | | | | | 28.0 | 13.07 | 6.6 |

### FICKLE DUCK LAKE (13W 442654E 7502915N NAD83)

| 18 July 2008 | | | 14 August 2008 | | | 9 September 2008 | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 10.9 | 13.3 | 0.0 | 11.77 | 11.5 | 0.0 | 13.75 | 4.1 |
| 0.5 | 10.8 | 13.6 | 0.5 | 11.77 | 11.5 | 0.5 | 13.74 | 4.1 |
| 1.0 | 10.7 | 13.7 | 1.0 | 11.76 | 11.5 | 1.0 | 13.74 | 4.1 |
| 1.5 | 10.7 | 13.8 | 1.5 | 11.74 | 11.5 | 1.5 | 13.72 | 4.1 |
| 2.0 | 10.7 | 13.9 | 2.0 | 11.75 | 11.5 | 2.0 | 13.73 | 4.1 |
| 2.3 | 10.6 | 13.9 | 2.5 | 11.74 | 11.5 | 2.5 | 13.72 | 4.2 |
| | | | | | | 3.0 | 13.64 | 4.2 |

### REFERENCE LAKE (13W 437989E 7503665N NAD83)

| 19 July 2008 | | | 15 August 2008 | | | 9 September 2008 | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 10.9 | 13.0 | 0.0 | 11.70 | 11.5 | 0.0 | 13.73 | 4.6 |
| 0.5 | 10.8 | 13.4 | 0.5 | 11.80 | 11.2 | 0.5 | 13.74 | 4.0 |
| 1.0 | 10.8 | 13.5 | 1.0 | 11.81 | 11.2 | 1.0 | 13.75 | 4.0 |
| 1.5 | 10.8 | 13.6 | 1.5 | 11.83 | 11.1 | 1.5 | 13.75 | 4.0 |
| 2.0 | 10.7 | 13.6 | 2.0 | 11.83 | 11.1 | 2.0 | 13.76 | 4.0 |
| 2.5 | 10.7 | 13.6 | 2.5 | 11.84 | 11.0 | 2.5 | 13.76 | 4.0 |
| 3.0 | 10.7 | 13.6 | 3.0 | 11.84 | 11.0 | 3.0 | 13.76 | 4.0 |
| | | | 3.5 | 11.81 | 10.9 | 3.5 | 13.76 | 4.0 |

**Appendix B4. Dissolved oxygen and water temperature profiles, 2008.**

| STICKLEBACK LAKE (13W 441726E 7503485N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 18 July 2008 | | | 14 August 2008 | | | 9 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.3 | 10.9 | 0.0 | 12.04 | 12.0 | 0.0 | 14.01 | 4.1 |
| 0.5 | 12.2 | 11.1 | 0.5 | 12.04 | 12.0 | 0.5 | 13.96 | 4.1 |
| 1.0 | 12.2 | 11.1 | 1.0 | 12.04 | 12.0 | 1.0 | 13.95 | 4.1 |
| 1.5 | 12.2 | 11.2 | 1.5 | 12.03 | 12.0 | 1.5 | 13.94 | 4.1 |
| 2.0 | 12.2 | 11.2 | 2.0 | 12.04 | 12.0 | 2.0 | 13.95 | 4.1 |
| 2.5 | 12.1 | 11.2 | 2.5 | 12.04 | 12.0 | 2.5 | 13.95 | 4.3 |
| | | | | | | 3.0 | 13.91 | 4.4 |

## DORIS PROJECT AREA

| DORIS LAKE (13W 433799E 7558286N NAD83) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 May 2008 | | | 16 July 2008 | | | 16 August 2008 | | | 11 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | | | 0.0 | 11.4 | 5.8 | 0.0 | 12.62 | 10.8 | 0.0 | 13.20 | 6.3 |
| 1.0 | Ice | | 1.0 | 11.7 | 5.2 | 1.0 | 12.52 | 11.0 | 1.0 | 13.12 | 6.2 |
| 2.0 | | | 2.0 | 11.8 | 5.0 | 2.0 | 12.48 | 11.1 | 2.0 | 13.12 | 6.2 |
| 3.0 | 10.18 | | 3.0 | 11.9 | 4.8 | 3.0 | 12.44 | 11.1 | 3.0 | 13.10 | 6.4 |
| 4.0 | 10.20 | | 4.0 | 11.9 | 4.7 | 4.0 | 12.40 | 11.1 | 4.0 | 13.09 | 6.4 |
| 5.0 | 10.20 | Not measured due to equipment malfunction | 5.0 | 11.9 | 4.6 | 5.0 | 12.40 | 11.2 | 5.0 | 13.08 | 6.4 |
| 6.0 | 10.21 | | 6.0 | 11.9 | 4.6 | 6.0 | 12.39 | 11.2 | 6.0 | 13.08 | 6.4 |
| 7.0 | 10.21 | | 7.0 | 11.9 | 4.6 | 7.0 | 12.39 | 11.1 | 7.0 | 13.07 | 6.4 |
| 8.0 | 10.16 | | 8.0 | 11.9 | 4.5 | 8.0 | 12.37 | 11.2 | 8.0 | 13.05 | 6.4 |
| 9.0 | 10.10 | | 9.0 | 12.0 | 4.5 | 9.0 | 12.37 | 11.2 | 9.0 | 13.05 | 6.4 |
| 10.0 | 10.02 | | 10.0 | 12.0 | 4.4 | 10.0 | 12.35 | 11.2 | 10.0 | 13.05 | 6.4 |
| 11.0 | 9.90 | | 11.0 | 12.0 | 4.4 | 11.0 | 12.36 | 11.2 | 11.0 | 13.04 | 6.4 |
| 12.0 | 9.68 | | 12.0 | 12.0 | 4.4 | 12.0 | 12.35 | 11.2 | 12.0 | 13.04 | 6.4 |
| 13.0 | 9.70 | | 13.0 | 12.0 | 4.4 | 13.0 | 11.62 | 11.3 | 13.0 | 13.03 | 6.4 |
| | | | 14.0 | 12.0 | 4.4 | 14.0 | 11.53 | 11.3 | 13.5 | 12.92 | 6.5 |
| | | | 14.8 | 12.0 | 4.3 | 15.0 | 10.69 | 11.3 | | | |

| LITTLE ROBERTS LAKE (13W 434723E 7562724N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 14 July 2008 | | | 18 August 2008 | | | 12 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.2 | 6.3 | 0.0 | 12.49 | 9.4 | 0.0 | 14.02 | 4.1 |
| 0.5 | 12.2 | 6.4 | 0.5 | 12.50 | 9.4 | 0.5 | 13.98 | 4.2 |
| 1.0 | 12.2 | 6.4 | 1.0 | 12.51 | 9.4 | 1.0 | 13.96 | 4.2 |
| 1.5 | 12.2 | 6.4 | 1.5 | 12.53 | 9.1 | 1.5 | 13.96 | 4.2 |
| 2.0 | 12.2 | 6.4 | 2.0 | 12.54 | 8.8 | 2.0 | 13.95 | 4.2 |
| 2.3 | 12.2 | 6.5 | 2.5 | 12.60 | 8.6 | 2.1 | 13.85 | 4.3 |

| ROBERTS LAKE (13W 435587E 7562161N NAD 83) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 25 May 2008 | | | 15 July 2008 | | | 18 August 2008 | | | 12 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | | | 0.0 | 12.2 | 8.0 | 0.0 | 12.96 | 9.0 | 0.0 | 13.85 | 4.7 |
| 0.5 | | | 0.5 | 12.3 | 7.9 | 0.5 | 12.90 | 9.2 | 0.5 | 13.81 | 4.8 |
| 1.0 | Ice | | 1.0 | 12.3 | 7.8 | 1.0 | 12.86 | 9.3 | 1.0 | 13.80 | 4.8 |
| 1.5 | | | 1.5 | 12.4 | 7.8 | 1.5 | 12.84 | 9.3 | 1.5 | 13.79 | 4.8 |
| 1.9 | | Not measured due to equipment malfunction | 2.0 | 12.4 | 7.7 | 2.0 | 12.81 | 9.4 | 2.0 | 13.79 | 4.8 |
| 2.0 | 11.60 | | 2.5 | 12.4 | 7.6 | 2.5 | 12.80 | 9.4 | 2.5 | 13.78 | 4.8 |
| 2.5 | 12.95 | | 3.0 | 12.4 | 7.6 | 3.0 | 12.78 | 9.4 | 3.0 | 13.77 | 4.8 |
| 3.0 | 14.60 | | 3.5 | 12.4 | 7.3 | 3.5 | 12.76 | 9.4 | 3.5 | 13.78 | 4.8 |
| 3.5 | 13.70 | | 4.0 | 12.5 | 7.1 | 4.0 | 12.76 | 9.4 | 4.0 | 13.77 | 4.8 |
| 4.0 | 11.04 | | 4.5 | 12.5 | 7.0 | 4.5 | 12.71 | 9.4 | 4.5 | 13.76 | 4.8 |
| 4.5 | 9.74 | | 4.8 | 12.5 | 6.9 | | | | 5.0 | 13.69 | 4.8 |
| 4.8 | 9.04 | | | | | | | | | | |

| TAIL LAKE (13W 434987E 7557952N NAD83) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 May 2008 | | | 14 July 2008 | | | 18 August 2008 | | | 11 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | | | 0.0 | 11.8 | 8.6 | 0.0 | n.d. | n.d. | 0.0 | 13.75 | 4.3 |
| 0.5 | Ice | | 0.5 | 11.7 | 8.7 | 0.5 | 12.13 | 10.1 | 0.5 | 13.72 | 4.3 |
| 1.0 | | | 1.0 | 11.7 | 8.7 | 1.0 | 12.06 | 10.1 | 1.0 | 13.72 | 4.3 |
| 1.5 | | | 1.5 | 11.7 | 8.7 | 1.5 | 12.07 | 10.1 | 1.5 | 13.72 | 4.3 |
| 2.0 | 9.88 | Not measured due to equipment malfunction | 2.0 | 11.7 | 8.8 | 2.0 | 12.06 | 10.0 | 2.0 | 13.69 | 4.3 |
| 2.5 | 9.80 | | 2.5 | 11.7 | 8.8 | 2.5 | 12.05 | 10.0 | 2.5 | 13.69 | 4.3 |
| 3.0 | 9.78 | | 3.0 | 11.7 | 8.8 | 3.0 | 12.05 | 10.0 | 3.0 | 13.69 | 4.3 |
| 3.5 | 9.86 | | 3.5 | 11.7 | 8.8 | 3.5 | 12.04 | 10.0 | 3.5 | 13.70 | 4.3 |
| 4.0 | 9.43 | | 4.0 | 11.7 | 8.8 | 4.0 | 12.06 | 10.0 | 4.0 | 13.69 | 4.3 |
| 4.5 | 8.66 | | 4.5 | 11.7 | 8.8 | 4.5 | 12.05 | 10.0 | 4.5 | 13.69 | 4.3 |
| 5.0 | 7.99 | | | | | 5.0 | 12.05 | 9.9 | 5.0 | 13.61 | 4.4 |
| 5.5 | 8.18 | | | | | | | | | | |

## MADRID PROJECT AREA

### GLENN LAKE (13W 0430135E 7560540N NAD83)

| 15 July 2008 | | | 18 August 2008 | | | 13 September 2008 | | |
|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 14.0 | 3.9 | 0.0 | 12.48 | 10.0 | 0.0 | 12.09 | 5.8 |
| 1.0 | 14.1 | 3.8 | 1.0 | 12.45 | 9.9 | 1.0 | 12.07 | 5.8 |
| 2.0 | 14.2 | 3.7 | 2.0 | 12.39 | 9.6 | 2.0 | 12.05 | 5.8 |
| 3.0 | 14.2 | 3.7 | 3.0 | 12.35 | 9.4 | 3.0 | 12.05 | 5.8 |
| 4.0 | 14.2 | 3.6 | 4.0 | 12.32 | 9.2 | 4.0 | 12.04 | 5.8 |
| 5.0 | 14.2 | 3.6 | 5.0 | 12.30 | 9.0 | 5.0 | 12.04 | 5.8 |
| 6.0 | 14.3 | 3.6 | 6.0 | 12.28 | 8.8 | 6.0 | 12.03 | 5.8 |
| 7.0 | 14.3 | 3.4 | 7.0 | 12.28 | 7.5 | 7.0 | 12.04 | 5.8 |
| 8.0 | 14.5 | 3.2 | 8.0 | 12.27 | 7.2 | 8.0 | 12.04 | 5.8 |
| 9.0 | 14.6 | 3.1 | 9.0 | 12.27 | 7.4 | 9.0 | 12.03 | 5.8 |
| 10.0 | 14.7 | 3.2 | 10.0 | 12.26 | 7.3 | 10.0 | 12.03 | 5.8 |
| 11.0 | 14.7 | 3.2 | 11.0 | 12.25 | 7.1 | 11.0 | 12.03 | 5.8 |
| 12.0 | 14.7 | 3.2 | 12.0 | 12.25 | 7.1 | 12.0 | 12.03 | 5.8 |
| 13.0 | 14.7 | 3.2 | 13.0 | 12.25 | 7.2 | 13.0 | 12.02 | 5.8 |
| 14.0 | 14.7 | 3.2 | 14.0 | 12.24 | 7.1 | 14.0 | 12.01 | 5.8 |
| 15.0 | 14.7 | 3.0 | 15.0 | 12.23 | 6.9 | 15.0 | 12.02 | 5.8 |
| 16.0 | 14.6 | 2.9 | 16.0 | 12.24 | 7.0 | 16.0 | 12.02 | 5.8 |
| 17.0 | 14.7 | 2.9 | 17.0 | 12.24 | 6.8 | 17.0 | 12.02 | 5.8 |
| 18.0 | 14.7 | 2.8 | 18.0 | 12.24 | 6.8 | 18.0 | 12.01 | 5.8 |
| 19.0 | 14.6 | 2.7 | | | | 18.7 | 11.95 | 5.9 |

### OGAMA LAKE (13W 436618E 7551843N NAD83)

| 24 May 2008 | | | 15 July 2008 | | | 17 August 2008 | | | 10 September 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | | | 0.0 | 11.7 | 9.6 | 0.0 | 12.43 | 11.3 | 0.0 | 13.71 | 4.4 |
| 0.5 | Ice | | 0.5 | 11.6 | 9.8 | 0.5 | 12.38 | 11.5 | 0.5 | 13.67 | 4.4 |
| 1.0 | | | 1.0 | 11.5 | 9.9 | 1.0 | 12.35 | 11.6 | 1.0 | 13.66 | 4.4 |
| 1.5 | | | 1.5 | 11.5 | 9.9 | 1.5 | 12.32 | 11.6 | 1.5 | 13.66 | 4.4 |
| 2.0 | 7.39 | | 2.0 | 11.5 | 10.0 | 2.0 | 12.29 | 11.7 | 2.0 | 13.66 | 4.4 |
| 2.5 | 6.20 | Not | 2.5 | 11.5 | 10.0 | 2.5 | 12.29 | 11.7 | 2.5 | 13.66 | 4.4 |
| 3.0 | 6.11 | measured | 3.0 | 11.5 | 10.1 | 3.0 | 12.26 | 11.7 | 3.0 | 13.66 | 4.4 |
| 3.5 | 5.99 | due to | 3.5 | 11.5 | 10.1 | 3.5 | 12.26 | 11.7 | 3.5 | 13.65 | 4.4 |
| 4.0 | 5.90 | equipment | 4.0 | 11.4 | 10.1 | 4.0 | 12.25 | 11.7 | 4.0 | 13.65 | 4.4 |
| 4.5 | 5.81 | malfunction | 4.5 | 11.4 | 10.1 | 4.5 | 12.25 | 11.7 | 4.5 | 13.64 | 4.4 |
| 5.0 | 5.79 | | 5.0 | 11.4 | 10.1 | 5.0 | 12.24 | 11.7 | 5.0 | 13.63 | 4.4 |
| 5.5 | 5.80 | | 5.3 | 11.4 | 10.1 | 5.5 | 12.23 | 11.7 | 5.5 | 13.63 | 4.5 |
| 6.0 | 5.87 | | | | | | | | 6.0 | 13.64 | 4.5 |
| 6.5 | 5.99 | | | | | | | | 6.5 | 13.65 | 4.4 |
| | | | | | | | | | 7.0 | 13.64 | 4.5 |

### PATCH LAKE (13W 435156E 7549509N NAD83)

| 23 May 2008 | | | 17 July 2008 | | | 15 August 2008 | | | 10 September 2008 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.00 | | | 0.0 | 12.1 | 10.2 | 0.0 | 12.02 | 12.2 | 0.0 | 13.49 | 5.0 |
| 0.50 | | | 1.0 | 12.6 | 8.7 | 1.0 | 11.97 | 12.3 | 0.5 | 13.34 | 5.2 |
| 1.00 | Ice | | 2.0 | 12.7 | 8.5 | 2.0 | 11.96 | 12.3 | 1.0 | 13.33 | 5.2 |
| 1.50 | | | 3.0 | 12.7 | 8.4 | 3.0 | 11.96 | 12.3 | 1.5 | 13.32 | 5.2 |
| 2.00 | | | 4.0 | 12.7 | 8.2 | 4.0 | 11.96 | 12.3 | 2.0 | 13.31 | 5.2 |
| 2.50 | 13.50 | | 5.0 | 12.8 | 7.9 | 5.0 | 11.95 | 12.2 | 2.5 | 13.31 | 5.2 |
| 3.00 | 13.41 | | 6.0 | 12.8 | 7.8 | 6.0 | 12.00 | 12.2 | 3.0 | 13.30 | 5.2 |
| 3.50 | 13.38 | | 7.0 | 12.8 | 7.7 | 7.0 | 11.98 | 12.2 | 3.5 | 13.29 | 5.2 |
| 4.00 | 13.41 | | 8.0 | 12.8 | 7.6 | 8.0 | 11.95 | 12.2 | 4.0 | 13.30 | 5.2 |
| 4.50 | 13.38 | | 9.0 | 12.9 | 7.4 | 9.0 | 11.95 | 12.2 | 4.5 | 13.30 | 5.2 |
| 5.00 | 13.34 | | 10.0 | 12.8 | 6.9 | 10.0 | 11.93 | 12.2 | 5.0 | 13.30 | 5.2 |
| 5.50 | 13.30 | | 11.0 | 12.3 | 4.6 | 11.0 | 11.92 | 12.2 | 5.5 | 13.30 | 5.2 |
| 6.00 | 13.26 | Not | 12.0 | 12.2 | 4.1 | 12.0 | 11.92 | 12.2 | 6.0 | 13.30 | 5.2 |
| 6.50 | 13.25 | measured | 13.0 | 12.1 | 3.8 | 13.0 | 11.89 | 12.2 | 6.5 | 13.29 | 5.2 |
| 7.00 | 13.25 | due to | | | | | | | 7.0 | 13.29 | 5.2 |
| 7.50 | 13.15 | equipment | | | | | | | 7.5 | 13.30 | 5.2 |
| 8.00 | 13.09 | malfunction | | | | | | | 8.0 | 13.29 | 5.2 |
| 8.50 | 12.81 | | | | | | | | 8.5 | 13.30 | 5.2 |
| 9.00 | 12.70 | | | | | | | | 9.0 | 13.29 | 5.2 |
| 9.50 | 12.65 | | | | | | | | 9.5 | 13.31 | 5.2 |
| 10.00 | 12.29 | | | | | | | | 10.0 | 13.31 | 5.2 |
| 10.50 | 11.99 | | | | | | | | 10.5 | 13.31 | 5.2 |
| 11.00 | 11.86 | | | | | | | | 11.0 | 13.30 | 5.2 |
| 11.50 | 11.79 | | | | | | | | 11.5 | 13.30 | 5.2 |
| 12.00 | 11.60 | | | | | | | | 12.0 | 13.30 | 5.2 |
| 12.50 | 11.60 | | | | | | | | 12.5 | 13.29 | 5.2 |
| | | | | | | | | | 13.0 | 13.28 | 5.2 |
| | | | | | | | | | 13.5 | 13.25 | 5.2 |

**Appendix B4. Dissolved oxygen and water temperature profiles, 2008.**

| PELVIC LAKE (13W 439637E 7552552N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 15 July 2008 | | | 17 August 2008 | | | 11 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.0 | 8.2 | 0.0 | 12.30 | 11.8 | 0.0 | 13.52 | 5.4 |
| 1.0 | 11.9 | 8.3 | 1.0 | 12.28 | 11.9 | 1.0 | 13.56 | 5.4 |
| 2.0 | 11.9 | 8.4 | 2.0 | 12.23 | 12.0 | 2.0 | 13.58 | 5.3 |
| 3.0 | 11.9 | 8.4 | 3.0 | 12.21 | 12.0 | 3.0 | 13.55 | 5.4 |
| 4.0 | 11.8 | 8.4 | 4.0 | 12.22 | 12.0 | 4.0 | 13.52 | 5.4 |
| 5.0 | 11.8 | 8.4 | 5.0 | 12.15 | 12.0 | 5.0 | 13.51 | 5.4 |
| 6.0 | 11.7 | 8.3 | 6.0 | 12.15 | 12.0 | 6.0 | 13.47 | 5.4 |
| 7.0 | 11.7 | 8.2 | 7.0 | 12.11 | 12.1 | 7.0 | 13.49 | 5.4 |
| 8.0 | 11.8 | 8.2 | 8.0 | 12.09 | 12.1 | 8.0 | 13.47 | 5.4 |
| 9.0 | 10.5 | 6.9 | 9.0 | 12.08 | 12.1 | 9.0 | 13.45 | 5.4 |
| 10.0 | 8.7 | 5.6 | 10.0 | 12.08 | 12.1 | 10.0 | 13.42 | 5.4 |
| 11.0 | 7.1 | 4.5 | 11.0 | 12.09 | 12.1 | 11.0 | 13.44 | 5.4 |
| 12.0 | 6.7 | 3.7 | 12.0 | 12.10 | 12.1 | 12.0 | 13.42 | 5.4 |
| 13.0 | 5.1 | 3.2 | 13.0 | 12.11 | 12.1 | 13.0 | 13.41 | 5.4 |
| 14.0 | 3.1 | 2.9 | 14.0 | 12.12 | 12.1 | 14.0 | 13.41 | 5.4 |
| 14.3 | 2.6 | 2.8 | 15.0 | 12.11 | 12.1 | 15.0 | 13.36 | 5.4 |
| | | | 15.5 | 12.05 | 12.1 | 16.0 | 13.32 | 5.4 |
| | | | | | | 16.5 | 13.18 | 5.3 |

| P.O. LAKE (13W 435585E 7547768N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 14 July 2008 | | | 17 August 2008 | | | 10 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.2 | 9.5 | 0.0 | 12.35 | 11.2 | 0.0 | 13.61 | 4.4 |
| 0.5 | 12.2 | 9.7 | 0.5 | 12.27 | 11.3 | 0.5 | 13.60 | 4.4 |
| 1.0 | 12.2 | 9.7 | 1.0 | 12.22 | 11.4 | 1.0 | 13.60 | 4.4 |
| 1.5 | 12.2 | 9.8 | 1.5 | 12.20 | 11.4 | 1.5 | 13.58 | 4.4 |
| 2.0 | 12.1 | 9.8 | 2.0 | 12.17 | 11.5 | 2.0 | 13.57 | 4.4 |
| 2.5 | 12.1 | 9.8 | 2.5 | 12.15 | 11.5 | 2.5 | 13.57 | 4.4 |
| 2.8 | 12.1 | 9.8 | | | | 3.0 | 13.57 | 4.4 |
| | | | | | | 3.5 | 13.53 | 4.4 |
| | | | | | | 4.0 | 13.52 | 4.5 |

| WINDY LAKE (13W 431586E 7553247N NAD83) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 May 2008 | | | 20 July 2008 | | | 19 August 2008 | | | 14 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | Ice | | 0.0 | 14.9 | 4.9 | 0.0 | 12.95 | 9.2 | 0.0 | 12.22 | 5.6 |
| 1.0 | | | 1.0 | 15.1 | 4.6 | 1.0 | 12.88 | 9.5 | 1.0 | 12.22 | 5.7 |
| 2.0 | 15.50 | | 2.0 | 15.2 | 4.4 | 2.0 | 12.85 | 9.6 | 2.0 | 12.21 | 5.7 |
| 3.0 | 15.28 | | 3.0 | 15.3 | 4.3 | 3.0 | 12.80 | 9.6 | 3.0 | 12.21 | 5.7 |
| 4.0 | 15.27 | | 4.0 | 15.4 | 4.1 | 4.0 | 12.78 | 9.7 | 4.0 | 12.20 | 5.7 |
| 5.0 | 15.25 | | 5.0 | 15.5 | 4.0 | 5.0 | 12.77 | 9.7 | 5.0 | 12.21 | 5.7 |
| 6.0 | 15.24 | | 6.0 | 15.5 | 4.0 | 6.0 | 12.76 | 9.7 | 6.0 | 12.21 | 5.7 |
| 7.0 | 15.15 | Not | 7.0 | 15.5 | 4.0 | 7.0 | 12.75 | 9.8 | 7.0 | 12.21 | 5.7 |
| 8.0 | 15.09 | measured | 8.0 | 15.5 | 4.0 | 8.0 | 12.73 | 9.8 | 8.0 | 12.22 | 5.7 |
| 9.0 | 15.01 | due to | 9.0 | 15.6 | 4.0 | 9.0 | 12.73 | 9.8 | 9.0 | 12.21 | 5.7 |
| 10.0 | 14.90 | equipment | 10.0 | 15.6 | 4.0 | 10.0 | 12.72 | 9.8 | 10.0 | 12.20 | 5.7 |
| 11.0 | 14.83 | malfunction | 11.0 | 15.6 | 4.0 | 11.0 | 12.71 | 9.8 | 11.0 | 12.19 | 5.7 |
| 12.0 | 14.56 | | 12.0 | 15.6 | 4.0 | 12.0 | 12.70 | 9.8 | 12.0 | 12.19 | 5.7 |
| 13.0 | 14.48 | | 13.0 | 15.6 | 4.0 | 13.0 | 12.70 | 9.8 | 13.0 | 12.18 | 5.7 |
| 14.0 | 14.29 | | 14.0 | 15.7 | 4.0 | 14.0 | 12.70 | 9.8 | 14.0 | 12.19 | 5.7 |
| 15.0 | 13.80 | | 15.0 | 15.6 | 4.0 | 15.0 | 12.69 | 9.8 | 15.0 | 12.20 | 5.7 |
| 16.0 | 13.16 | | 16.0 | 15.7 | 3.9 | 16.0 | 12.68 | 9.8 | 16.0 | 12.20 | 5.7 |
| 17.0 | 12.66 | | 17.0 | 15.7 | 4.0 | 17.0 | 12.68 | 9.8 | 17.0 | 12.19 | 5.7 |
| | | | | | | 18.0 | 11.80 | 9.8 | 18.0 | 12.19 | 5.7 |

| WOLVERINE LAKE (13W 434855E 7545873N NAD83) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 May 2008 | | | 14 July 2008 | | | 15 August 2008 | | | 10 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | | Not | 0.0 | 11.8 | 9.5 | 0.0 | 12.47 | 11.8 | 0.0 | 13.79 | 4.3 |
| 0.5 | | measured | 0.5 | 11.9 | 9.4 | 0.5 | 12.46 | 11.8 | 0.5 | 13.82 | 4.2 |
| 1.0 | Ice | due to | 1.0 | 11.9 | 9.3 | 1.0 | 12.48 | 11.8 | 1.0 | 13.81 | 4.2 |
| 1.5 | | equipment | 1.5 | 11.9 | 9.3 | 1.5 | 12.48 | 11.8 | 1.5 | 13.81 | 4.2 |
| 1.8 | | malfunction | 2.0 | 11.9 | 9.3 | 2.0 | 12.56 | 11.8 | 2.0 | 13.80 | 4.2 |
| 2.0 | 7.70 | | | | | | | | 2.5 | 12.93 | 4.4 |

## MARINE BAYS

| HOPE BAY (13W 427587E 7555296N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 16 July 2008 | | | 19 August 2008 | | | 13 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.2 | 9.8 | 0.0 | 13.10 | 8.9 | 0.0 | 12.98 | 4.7 |
| 1.0 | 12.2 | 8.4 | 1.0 | 13.02 | 9.0 | 1.0 | 12.54 | 5.2 |
| 2.0 | 12.3 | 7.0 | 2.0 | 12.98 | 9.1 | 2.0 | 12.55 | 5.2 |
| 3.0 | 13.4 | 5.3 | 3.0 | 13.04 | 9.6 | 3.0 | 12.54 | 5.2 |
| 4.0 | 14.8 | 3.3 | 4.0 | 12.98 | 9.7 | 4.0 | 12.47 | 5.2 |
| 5.0 | 14.9 | 1.6 | 5.0 | 12.89 | 9.6 | 5.0 | 12.41 | 5.0 |
| 6.0 | 14.9 | 1.3 | 6.0 | 12.88 | 9.5 | 6.0 | 12.50 | 4.4 |
| 7.0 | 14.7 | 0.8 | 7.0 | 12.90 | 9.3 | 7.0 | 12.61 | 4.2 |
| 8.0 | 14.5 | 0.4 | 8.0 | 13.16 | 8.7 | 8.0 | 12.77 | 3.9 |
| 9.0 | 14.5 | 0.2 | 9.0 | 13.50 | 8.1 | 9.0 | 12.84 | 3.8 |
| | | | 10.0 | 13.85 | 7.3 | 10.0 | 12.88 | 3.6 |
| | | | 11.0 | 14.50 | 5.6 | 11.0 | 12.91 | 3.5 |
| | | | 12.0 | 14.68 | 5.1 | 12.0 | 12.91 | 3.5 |
| | | | 13.0 | 14.90 | 4.2 | 13.0 | 12.91 | 3.3 |
| | | | 14.0 | 15.40 | 2.3 | 14.0 | 12.98 | 3.2 |
| | | | 15.0 | 15.44 | 2.0 | 15.0 | 12.98 | 3.1 |
| | | | | | | 15.5 | 12.89 | 3.1 |

| ROBERTS BAY (13W 433290E 7564019N NAD83) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 16 July 2008 | | | 19 August 2008 | | | 13 September 2008 | | |
| Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) | Depth (m) | DO (mg/L) | Temp (°C) |
| 0.0 | 12.8 | 8.4 | 0.0 | 13.22 | 7.7 | 0.0 | 12.87 | 4.3 |
| 0.5 | 12.7 | 8.2 | 0.5 | 13.09 | 9.1 | 0.5 | 12.89 | 4.1 |
| 1.0 | 12.7 | 8.1 | 1.0 | 13.02 | 9.2 | 1.0 | 12.90 | 4.2 |
| 1.5 | 12.7 | 8.1 | 1.5 | 12.98 | 9.4 | 1.5 | 12.91 | 4.5 |
| 2.0 | 12.6 | 7.9 | 2.0 | 12.95 | 9.5 | 2.0 | 12.90 | 4.3 |
| 2.5 | 12.7 | 7.7 | 2.5 | 12.80 | 9.7 | 2.5 | 12.89 | 4.4 |
| 3.0 | 12.7 | 7.2 | 3.0 | 12.79 | 9.8 | 3.0 | 12.84 | 4.4 |
| 3.5 | 13.4 | 6.6 | 3.5 | 12.62 | 9.9 | 3.5 | 12.83 | 4.4 |
| 3.8 | 13.7 | 5.9 | | | | 4.0 | 12.88 | 4.6 |

# APPENDIX B5

# ANALYTICAL RESULTS
# FOR FRESHWATER
# WATER QUALITY SAMPLES

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Aimaokatalok River | | | | Aimaokatalok Inflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-Jun-08 | 19-Jul-08 | 15-Aug-08 | 15-Sep-08 | 24-Jun-08 | 19-Jul-08 | 13-Aug-08 | 8-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 5.5 | 6.8 | 8.8 | 7.6 | 7.2 | 11.4 | 13.7 | 12.7 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 7.3 | 8.0 | 11.9 | 11.1 | 11.0 | 16.4 | 19.6 | 21.2 |
| Specific Conductivity (lab) | µS/cm | | | 26.9 | 31.4 | 47.5 | 40.8 | 44.3 | 76.5 | 85.4 | 93 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.7 | 7.0 | 7.5 | 7.3 | 6.6 | 7.3 | 7.2 | 8.4 |
| Total Dissolved Solids | mg/L | | <500 | 16.3 | 15.5 | 21.5 | 19.6 | 22.4 | 36.1 | 51.3 | 43.7 |
| Total Suspended Solids | mg/L | | | 4 | <1 | <1 | <1 | 13 | 2 | 4 | 5 |
| True Colour | TCU | | <15 | **19** | 7 | **21** | **27** | **35** | **16** | **60** | **52** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 14 | 13 | 11 | 9 | 27 | 27 | 34 | 31 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.27 | 0.23 | 0.36 | 0.31 | 0.33 | 0.43 | 0.67 | 0.70 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.008 | 0.004 | 0.008 | 0.014 | 0.012 | 0.010 | 0.014 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | 0.012 | 0.006 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | 0.012 | 0.006 | 0.006 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.38 | 0.15 | 0.68 | 0.30 | 0.74 | 0.67 | 1.67 | 1.31 |
| Dissolved Organic Carbon | mg/L | | | 5.0 | 3.6 | 6.1 | 5.8 | 6.4 | 6.0 | 11.0 | 9.3 |
| Total Organic Carbon | mg/L | | | 5.38 | 3.75 | 6.78 | 6.10 | 7.14 | 6.67 | 12.67 | 10.61 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 7 | 8 | 11 | 9 | 9 | 14 | 17 | 15 |
| Calcium (total) | mg/L | | | 1.32 | 1.53 | 2.61 | 1.94 | 1.95 | 3.00 | 3.92 | 3.89 |
| Calcium (extractable) | mg/L | | | 1.32 | 1.51 | 2.48 | 1.99 | 1.94 | 3.02 | 3.74 | 3.90 |
| Calcium (dissolved) | mg/L | | | 1.27 | 1.43 | 2.51 | 1.73 | 1.79 | 2.86 | 3.79 | 3.68 |
| Chloride | mg/L | | <250 | 3.7 | 4.3 | 6.1 | 5.9 | 7.7 | 14.4 | 15.9 | 17.7 |
| Magnesium (total) | mg/L | | | 0.91 | 1.07 | 1.45 | 1.56 | 1.34 | 2.20 | 2.63 | 2.81 |
| Magnesium (extractable) | mg/L | | | 0.97 | 1.02 | 1.38 | 1.50 | 1.49 | 2.14 | 2.49 | 2.78 |
| Magnesium (dissolved) | mg/L | | | 0.85 | 1.03 | 1.40 | 1.38 | 1.16 | 2.14 | 2.55 | 2.66 |
| Potassium (total) | mg/L | | | 0.586 | 0.481 | 0.479 | 0.467 | 0.926 | 0.834 | 0.735 | 0.823 |
| Potassium (extractable) | mg/L | | | 0.5 | 0.5 | 0.4 | 0.4 | 0.6 | 0.7 | 0.6 | 0.7 |
| Potassium (dissolved) | mg/L | | | 0.53 | 0.46 | 0.46 | 0.41 | 0.61 | 0.77 | 0.66 | 0.67 |
| Sodium (total) | mg/L | | | 1.86 | 2.18 | 3.15 | 3.12 | 3.96 | 7.36 | 8.46 | 9.06 |
| Sodium (extractable) | mg/L | | | 2.1 | 2.1 | 3.8 | 3.2 | 4.3 | 6.9 | 8.3 | 9.0 |
| Sodium (dissolved) | mg/L | | | 1.84 | 2.12 | 3.12 | 2.80 | 3.94 | 7.23 | 8.26 | 8.70 |
| Sulfate | mg/L | | <500 | 4 | <3 | <3 | <3 | <3 | <3 | 12 | <3 |
| Anions | meq/L | | | 0.31 | 0.30 | 0.39 | 0.36 | 0.40 | 0.68 | 0.97 | 0.80 |
| Cations | meq/L | | | 0.25 | 0.26 | 0.42 | 0.37 | 0.42 | 0.65 | 0.77 | 0.83 |
| Ionic Balance | N/A | | | 0.80 | 0.88 | 1.06 | 1.03 | 1.05 | 0.95 | 0.79 | 1.04 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **155** | 17.4 | 53.0 | 45.6 | **836** | **123** | **196** | **302** |
| Antimony | µg/L | | 6 | 0.003 | 0.003 | 0.006 | 0.007 | 0.008 | 0.014 | 0.011 | 0.008 |
| Arsenic | µg/L | 5 | 10 | 0.125 | 0.117 | 0.170 | 0.169 | 0.286 | 0.361 | 0.434 | 0.395 |
| Barium | µg/L | | 1000 | 3.73 | 1.69 | 2.53 | 2.43 | 11.90 | 4.13 | 5.21 | 7.25 |
| Beryllium | µg/L | | | 0.007 | <0.003 | 0.006 | 0.003 | 0.036 | 0.006 | 0.017 | 0.009 |
| Bismuth | µg/L | | | <0.001 | <0.001 | 0.002 | 0.002 | <0.001 | <0.001 | 0.004 | <0.001 |
| Boron | µg/L | | 5000 | 3.19 | 3.14 | 4.34 | 2.67 | 5.70 | 5.54 | 6.34 | 5.67 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.002 | 0.007 | <0.002 | 0.004 | 0.005 | **0.026** | 0.003 | 0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.30 | 0.29 | 0.27 | 0.36 | **1.34** | 0.57 | 0.64 | 0.78 |
| Cobalt | µg/L | | | 0.154 | 0.055 | 0.122 | 0.080 | 0.345 | 0.157 | 0.174 | 0.148 |
| Copper | µg/L | 2 - 4 | <1000 | 0.95 | 1.59 | 1.45 | **3.68** | 1.07 | 1.84 | 1.66 | 1.65 |
| Iron | µg/L | 300 | <300 | 250 | 141 | **350** | 172 | **887** | **517** | **643** | **425** |
| Lead | µg/L | 1 - 7 | 10 | 0.102 | 0.038 | 0.038 | 0.027 | 0.295 | 0.115 | 0.102 | 0.129 |
| Manganese | µg/L | | <50 | 11.9 | 3.0 | 6.2 | 4.1 | 21.2 | 13.2 | 15.1 | 11.4 |
| Mercury | ng/L | 26 | 1000 | 1.7 | 1.1 | 1.6 | 1.2 | 1.9 | 0.8 | 1.5 | 1.6 |
| Molybdenum | µg/L | 73 | | 0.027 | 0.023 | 0.059 | 0.040 | 0.072 | 0.158 | 0.192 | 0.104 |
| Nickel | µg/L | 25 - 150 | | 0.450 | 0.369 | 0.635 | 0.528 | 0.947 | 1.260 | 1.140 | 1.030 |
| Selenium | µg/L | 1 | 10 | <0.1 | 0.2 | 0.2 | 0.2 | <0.1 | 0.3 | 0.3 | 0.5 |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | 0.0114 | 0.0054 | 0.0116 | <0.0005 | 0.0083 | 0.0098 |
| Strontium | µg/L | | | 7.0 | 8.3 | 11.2 | 10.1 | 13.3 | 18.6 | 22.7 | 22.8 |
| Thallium | µg/L | 0.8 | | <0.0003 | <0.0003 | 0.0020 | 0.0033 | 0.0054 | <0.0003 | 0.0035 | 0.0021 |
| Tin | µg/L | | | <0.03 | <0.03 | 0.09 | <0.03 | 0.04 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0239 | 0.0216 | 0.0395 | 0.0444 | 0.0607 | 0.0423 | 0.0668 | 0.0697 |
| Vanadium | µg/L | | | 0.323 | 0.127 | 0.174 | 0.137 | 1.650 | 0.550 | 0.576 | 0.541 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.71 | 7.07 | 1.28 | 4.09 | 2.75 | 17.50 | 2.71 | 1.53 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 21.3 | 8.3 | 19.2 | 21.3 | 52.6 | 33.9 | 57.8 | 70.3 |
| Antimony | µg/L | | | 0.003 | 0.003 | 0.006 | 0.007 | 0.007 | 0.013 | 0.011 | 0.008 |
| Arsenic | µg/L | | | 0.105 | 0.106 | 0.143 | 0.142 | 0.179 | 0.330 | 0.363 | 0.315 |
| Barium | µg/L | | | 2.04 | 1.47 | 2.02 | 1.92 | 2.66 | 2.66 | 3.24 | 3.70 |
| Beryllium | µg/L | | | 0.004 | <0.003 | 0.004 | 0.003 | 0.003 | <0.003 | 0.011 | 0.009 |
| Boron | µg/L | | | 2.43 | 2.43 | 2.97 | 1.81 | 4.39 | 5.18 | 5.78 | 4.61 |
| Cadmium | µg/L | | | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.003 | <0.002 |
| Chromium | µg/L | | | 0.13 | 0.26 | 0.27 | 0.26 | 0.25 | 0.39 | 0.53 | 0.54 |
| Cobalt | µg/L | | | 0.074 | 0.033 | 0.042 | 0.046 | 0.076 | 0.051 | 0.082 | 0.067 |
| Copper | µg/L | | | 0.94 | 0.89 | 1.44 | 1.16 | 1.06 | 0.99 | 1.64 | 1.38 |
| Iron | µg/L | | | 82.6 | 94.7 | 95.9 | 80.4 | 193.0 | 273.0 | 226.0 | 171.0 |
| Lead | µg/L | | | 0.024 | 0.004 | 0.015 | 0.004 | 0.054 | 0.029 | 0.101 | 0.034 |
| Manganese | µg/L | | | 6.1 | 1.6 | 1.0 | 1.5 | 7.1 | 2.5 | 3.4 | 2.6 |
| Molybdenum | µg/L | | | 0.018 | 0.022 | 0.041 | 0.039 | 0.057 | 0.091 | 0.119 | 0.103 |
| Nickel | µg/L | | | 0.446 | 0.261 | 0.490 | 0.484 | 0.418 | 0.497 | 0.977 | 0.790 |
| Selenium | µg/L | | | <0.1 | 0.2 | 0.1 | 0.2 | <0.1 | 0.3 | 0.3 | 0.4 |
| Silver | µg/L | | | <0.0005 | <0.0005 | 0.0006 | 0.0018 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 7.0 | 7.8 | 11.1 | 9.0 | 11.5 | 17.6 | 22.3 | 20.7 |
| Uranium | µg/L | | | 0.0178 | 0.0172 | 0.0306 | 0.0366 | 0.0289 | 0.0315 | 0.0530 | 0.0570 |
| Vanadium | µg/L | | | 0.110 | 0.092 | 0.092 | 0.080 | 0.342 | 0.294 | 0.255 | 0.228 |
| Zinc | µg/L | | | 1.69 | 0.27 | 1.25 | 0.60 | 1.88 | 0.42 | 2.68 | 0.88 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | 0.020 | <0.005 | <0.005 | <0.005 | 0.030 | <0.005 | 0.008 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.02 | 0.03 | 0.03 | 0.03 | <0.01 | 0.04 | 0.05 | 0.04 |
| Sulphide | mg/L | | | | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 | 0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Aimaokatalok Lake Site 4 Top | | | | Aimaokatalok Lake Site 4 Bottom | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 22-May-08 | 19-Jul-08 | 14-Aug-08 | 8-Sep-08 | 22-May-08 | 19-Jul-08 | 14-Aug-08 | 8-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 12.7 | 7.7 | 8.6 | 9.2 | 12.2 | 8.5 | 8.6 | 9.0 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 17.7 | 9.6 | 11.2 | 12.6 | 17.3 | 9.7 | 11.6 | 12.8 |
| Specific Conductivity (lab) | µS/cm | | | 73.7 | 42.2 | 46.3 | 50.4 | 71 | 42.5 | 46.4 | 50.5 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.9 | 6.9 | 7.2 | 7.4 | 6.9 | 6.9 | 7.2 | 7.4 |
| Total Dissolved Solids | mg/L | | <500 | 37.8 | 19.9 | 22.9 | 24.4 | 38.8 | 21.1 | 22.7 | 26.2 |
| Total Suspended Solids | mg/L | | | <1 | 2 | <1 | 2 | <1 | <1 | <1 | 1 |
| True Colour | TCU | | <15 | **15** | 12 | 10 | **28** | **15** | **15** | 10 | **23** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 12 | 17 | 18 | 11 | 9 | 11 | 10 | 13 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.38 | 0.25 | 0.25 | 0.30 | 0.32 | 0.26 | 0.26 | 0.29 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.012 | 0.008 | 0.011 | 0.008 | 0.004 | 0.012 | 0.007 | 0.010 |
| Nitrite+Nitrate - N | mg/L | | | 0.023 | <0.005 | <0.005 | <0.005 | 0.029 | 0.005 | 0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.022 | <0.005 | <0.005 | <0.005 | 0.028 | 0.005 | 0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.06 | 0.23 | 0.37 | 0.20 | 0.04 | 0.38 | 0.33 | 0.25 |
| Dissolved Organic Carbon | mg/L | | | 5.4 | 3.8 | 4.6 | 4.6 | 5.3 | 4.4 | 4.9 | 4.9 |
| Total Organic Carbon | mg/L | | | 5.46 | 4.03 | 4.97 | 4.80 | 5.34 | 4.78 | 5.23 | 5.15 |
| Chlorophyll *a* | µg/L | | | - | 1.24 | 1.43 | 2.01 | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 15 | 9 | 10 | 11 | 15 | 10 | 11 | 11 |
| Calcium (total) | mg/L | | | 3.45 | 1.92 | 2.20 | 2.62 | 3.37 | 1.94 | 2.22 | 2.64 |
| Calcium (extractable) | mg/L | | | 3.54 | 1.91 | 2.19 | 2.54 | 3.45 | 1.92 | 2.26 | 2.56 |
| Calcium (dissolved) | mg/L | | | 3.32 | 1.82 | 2.09 | 2.39 | 3.19 | 1.85 | 2.10 | 2.45 |
| Chloride | mg/L | | <250 | 14.1 | 6.3 | 7.5 | 8.1 | 13.7 | 6.7 | 7.3 | 7.9 |
| Magnesium (total) | mg/L | | | 2.16 | 1.23 | 1.37 | 1.59 | 2.10 | 1.26 | 1.37 | 1.61 |
| Magnesium (extractable) | mg/L | | | 2.16 | 1.18 | 1.40 | 1.52 | 2.10 | 1.19 | 1.44 | 1.55 |
| Magnesium (dissolved) | mg/L | | | 2.05 | 1.18 | 1.29 | 1.45 | 2.04 | 1.19 | 1.30 | 1.48 |
| Potassium (total) | mg/L | | | 0.901 | 0.599 | 0.643 | 0.647 | 0.862 | 0.610 | 0.643 | 0.649 |
| Potassium (extractable) | mg/L | | | 1.0 | 0.6 | 0.6 | 0.6 | 1.2 | 0.6 | 0.6 | 0.6 |
| Potassium (dissolved) | mg/L | | | 0.84 | 0.57 | 0.60 | 0.58 | 0.82 | 0.58 | 0.60 | 0.58 |
| Sodium (total) | mg/L | | | 5.87 | 3.24 | 3.83 | 4.23 | 5.77 | 3.33 | 3.83 | 4.27 |
| Sodium (extractable) | mg/L | | | 7.3 | 3.2 | 4.0 | 4.2 | 7.2 | 3.6 | 3.9 | 4.1 |
| Sodium (dissolved) | mg/L | | | 5.61 | 3.13 | 3.68 | 3.94 | 5.56 | 3.31 | 3.71 | 3.99 |
| Sulfate | mg/L | | <500 | <3 | <3 | <3 | <3 | 4 | <3 | <3 | 4 |
| Anions | meq/L | | | 0.70 | 0.38 | 0.43 | 0.45 | 0.71 | 0.40 | 0.42 | 0.49 |
| Cations | meq/L | | | 0.70 | 0.35 | 0.42 | 0.45 | 0.69 | 0.36 | 0.42 | 0.45 |
| Ionic Balance | N/A | | | 1.00 | 0.92 | 0.98 | 0.99 | 0.96 | 0.91 | 0.98 | 0.92 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 11.8 | 54.1 | 53.2 | 71.8 | 10.9 | 56.2 | 47.8 | 68.7 |
| Antimony | µg/L | | 6 | 0.038 | 0.004 | 0.007 | 0.011 | 0.020 | 0.005 | 0.008 | 0.116 |
| Arsenic | µg/L | 5 | 10 | 0.097 | 0.175 | 0.167 | 0.189 | 0.098 | 0.159 | 0.158 | 0.180 |
| Barium | µg/L | | 1000 | 2.07 | 2.31 | 2.20 | 2.50 | 1.96 | 2.30 | 2.15 | 2.49 |
| Beryllium | µg/L | | | <0.003 | 0.005 | 0.008 | 0.005 | <0.003 | <0.003 | <0.003 | 0.005 |
| Bismuth | µg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | µg/L | | 5000 | 7.68 | 3.51 | 4.13 | 4.18 | 6.63 | 3.64 | 4.28 | 4.32 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.002 | 0.004 | <0.002 | <0.002 | <0.002 | <0.002 | 0.003 |
| Chromium | µg/L | 1 or 16 | 50 | 0.15 | 0.27 | 0.25 | 0.39 | 0.14 | 0.26 | 0.23 | 0.37 |
| Cobalt | µg/L | | | 0.154 | 0.071 | 0.045 | 0.043 | 0.018 | 0.074 | 0.039 | 0.040 |
| Copper | µg/L | 2 - 4 | <1000 | 0.89 | 0.91 | 0.95 | 1.15 | 1.11 | 0.90 | 0.93 | 1.06 |
| Iron | µg/L | 300 | <300 | 19.1 | 140 | 98.2 | 110 | 12.6 | 142 | 91.3 | 110 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.036 | 0.041 | 0.039 | <0.001 | 0.043 | 0.037 | 0.046 |
| Manganese | µg/L | | <50 | 1.5 | 11.3 | 6.6 | 4.8 | 1.5 | 11.5 | 6.4 | 4.7 |
| Mercury | ng/L | 26 | 1000 | <0.6 | 1.1 | 1.0 | 1.0 | <0.6 | 1.5 | 0.8 | 0.7 |
| Molybdenum | µg/L | 73 | | 0.044 | 0.033 | 0.041 | 0.044 | 0.043 | 0.030 | 0.042 | 0.051 |
| Nickel | µg/L | 25 - 150 | | 0.479 | 0.403 | 0.689 | 0.498 | 0.418 | 0.404 | 0.459 | 0.500 |
| Selenium | µg/L | 1 | 10 | 0.3 | 0.2 | 0.2 | 0.4 | 0.4 | 0.1 | 0.1 | 0.4 |
| Silver | µg/L | 0.1 | | 0.0029 | <0.0005 | 0.0016 | <0.0005 | 0.0021 | <0.0005 | 0.0026 | <0.0005 |
| Strontium | µg/L | | | 18.7 | 10.0 | 11.5 | 12.5 | 18.0 | 10.2 | 11.5 | 12.7 |
| Thallium | µg/L | 0.8 | | 0.0013 | <0.0003 | 0.0024 | 0.0009 | 0.0008 | 0.0003 | 0.0022 | 0.0003 |
| Tin | µg/L | | | 1.06 | <0.03 | 0.05 | 0.08 | 0.08 | <0.03 | 0.05 | <0.03 |
| Uranium | µg/L | | 20 | 0.0278 | 0.0234 | 0.0244 | 0.0258 | 0.0263 | 0.0216 | 0.0244 | 0.0263 |
| Vanadium | µg/L | | | 0.027 | 0.168 | 0.125 | 0.175 | 0.050 | 0.183 | 0.139 | 0.188 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 0.85 | 0.70 | 1.29 | <0.1 | 0.99 | 1.12 | 1.27 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 4.2 | 14.9 | 12.3 | 14.2 | 4.2 | 15.2 | 13.0 | 14.2 |
| Antimony | µg/L | | | 0.038 | 0.004 | 0.007 | 0.011 | 0.019 | 0.005 | 0.008 | 0.115 |
| Arsenic | µg/L | | | <0.02 | 0.164 | 0.156 | 0.135 | <0.02 | 0.140 | 0.147 | 0.166 |
| Barium | µg/L | | | 1.87 | 1.73 | 1.59 | 1.65 | 1.80 | 1.74 | 1.59 | 1.64 |
| Beryllium | µg/L | | | <0.003 | <0.003 | 0.004 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 5.52 | 3.11 | 3.43 | 3.44 | 5.55 | 3.31 | 3.56 | 3.35 |
| Cadmium | µg/L | | | <0.002 | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.15 | 0.23 | 0.21 | 0.29 | 0.14 | 0.24 | 0.23 | 0.30 |
| Cobalt | µg/L | | | 0.021 | 0.030 | 0.026 | 0.025 | 0.018 | 0.029 | 0.021 | 0.024 |
| Copper | µg/L | | | 0.88 | 0.87 | 0.94 | 0.97 | 0.87 | 0.90 | 0.92 | 0.91 |
| Iron | µg/L | | | 4.8 | 60.5 | 30.1 | 39.2 | 3.9 | 58.0 | 32.0 | 37.3 |
| Lead | µg/L | | | <0.001 | 0.035 | 0.014 | 0.008 | <0.001 | 0.014 | 0.031 | 0.015 |
| Manganese | µg/L | | | 0.8 | 6.8 | 0.6 | 0.7 | 1.0 | 7.0 | 0.8 | 0.6 |
| Molybdenum | µg/L | | | 0.044 | 0.029 | 0.038 | 0.043 | 0.041 | 0.029 | 0.036 | 0.047 |
| Nickel | µg/L | | | 0.375 | 0.338 | 0.636 | 0.415 | 0.397 | 0.349 | 0.416 | 0.452 |
| Selenium | µg/L | | | <0.04 | 0.2 | 0.2 | 0.3 | <0.04 | 0.1 | 0.1 | 0.3 |
| Silver | µg/L | | | 0.0029 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 18.5 | 9.4 | 11.4 | 11.4 | 17.7 | 9.8 | 10.9 | 11.6 |
| Uranium | µg/L | | | 0.0211 | 0.0198 | 0.0190 | 0.0206 | 0.0216 | 0.0195 | 0.0178 | 0.0209 |
| Vanadium | µg/L | | | 0.026 | 0.081 | 0.070 | 0.088 | 0.050 | 0.086 | 0.089 | 0.099 |
| Zinc | µg/L | | | <0.05 | 0.84 | 0.69 | 1.05 | 0.05 | 0.98 | 1.11 | 1.12 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | 0.005 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.07 | 0.03 | 0.03 | 0.03 | <0.01 | 0.03 | 0.03 | 0.03 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Aimaokatalok Lake Site 6 Top | | | | Aimaokatalok Lake Site 6 Middle | Aimaokatalok Lake Site 6 Bottom | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 22-May-08 | 19-Jul-08 | 14-Aug-08 | 8-Sep-08 | 22-May-08 | 22-May-08 | 19-Jul-08 | 14-Aug-08 | 8-Sep-08 |
| **Physical** | | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 13.0 | 8.2 | 8.7 | 9.3 | 12.5 | 12.0 | 7.9 | 8.2 | 9.2 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 17.7 | 9.7 | 11.3 | 12.7 | 17.5 | 16.8 | 10.3 | 11.3 | 13.2 |
| Specific Conductivity (lab) | µS/cm | | | 76.7 | 41.1 | 46.8 | 52 | 74.3 | 74.9 | 43.3 | 46.8 | 51 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.8 | 6.7 | 7.4 | 7.3 | 6.8 | 6.8 | 6.7 | 7.4 | 7.3 |
| Total Dissolved Solids | mg/L | | <500 | 38.4 | 21.9 | 22.7 | 27.5 | 38.3 | 38.3 | 22.6 | 22.7 | 29.7 |
| Total Suspended Solids | mg/L | | | 4 | <1 | <1 | 2 | <1 | <1 | <1 | <1 | 1 |
| True Colour | TCU | | <15 | **15** | 12 | 10 | **28** | **15** | **15** | 12 | 10 | **28** |
| **Nutrients** | | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 21 | 9 | 13 | 21 | 10 | 13 | 14 | 11 | 14 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.48 | 0.24 | 0.27 | 0.28 | 0.45 | 0.42 | 0.28 | 0.26 | 0.29 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.005 | 0.009 | 0.009 | 0.013 | 0.013 | 0.005 | 0.006 | 0.008 |
| Nitrite+Nitrate - N | mg/L | | | 0.043 | 0.005 | <0.005 | <0.005 | 0.098 | 0.131 | 0.009 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.041 | 0.005 | <0.005 | <0.005 | 0.096 | 0.130 | 0.009 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | <0.02 | 0.36 | 0.37 | 0.15 | 0.05 | <0.02 | 0.40 | 0.35 | 0.41 |
| Dissolved Organic Carbon | mg/L | | | 5.3 | 5.7 | 4.9 | 5.0 | 5.0 | 4.4 | 4.5 | 4.8 | 5.1 |
| Total Organic Carbon | mg/L | | | 5.31 | 6.06 | 5.27 | 5.15 | 5.05 | 4.41 | 4.90 | 5.15 | 5.51 |
| Chlorophyll *a* | µg/L | | | - | 1.25 | 1.06 | 2.22 | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 16 | 10 | 11 | 11 | 15 | 15 | 10 | 10 | 11 |
| Calcium (total) | mg/L | | | 3.49 | 1.97 | 2.26 | 2.57 | 3.35 | 3.30 | 2.05 | 2.22 | 2.59 |
| Calcium (extractable) | mg/L | | | 3.55 | 1.92 | 2.19 | 2.55 | 3.50 | 3.32 | 2.04 | 2.19 | 2.66 |
| Calcium (dissolved) | mg/L | | | 3.39 | 1.84 | 2.15 | 2.46 | 3.31 | 3.13 | 1.90 | 2.16 | 2.42 |
| Chloride | mg/L | | <250 | 14.4 | 6.4 | 7.4 | 8.2 | 14.3 | 14.7 | 6.8 | 7.5 | 8.2 |
| Magnesium (total) | mg/L | | | 2.14 | 1.25 | 1.39 | 1.57 | 2.10 | 2.06 | 1.32 | 1.38 | 1.57 |
| Magnesium (extractable) | mg/L | | | 2.26 | 1.20 | 1.41 | 1.54 | 2.12 | 2.06 | 1.27 | 1.41 | 1.60 |
| Magnesium (dissolved) | mg/L | | | 2.18 | 1.20 | 1.33 | 1.50 | 2.08 | 1.97 | 1.25 | 1.32 | 1.45 |
| Potassium (total) | mg/L | | | 0.894 | 0.624 | 0.645 | 0.636 | 0.838 | 0.845 | 0.646 | 0.646 | 0.627 |
| Potassium (extractable) | mg/L | | | 1.0 | 0.6 | 0.6 | 0.6 | 1.1 | 1.0 | 0.6 | 0.6 | 0.5 |
| Potassium (dissolved) | mg/L | | | 0.85 | 0.58 | 0.62 | 0.59 | 0.83 | 0.80 | 0.59 | 0.62 | 0.57 |
| Sodium (total) | mg/L | | | 6.14 | 3.39 | 3.90 | 4.19 | 5.87 | 5.98 | 3.55 | 3.87 | 4.16 |
| Sodium (extractable) | mg/L | | | 7.3 | 3.2 | 4.0 | 4.5 | 7.4 | 7.4 | 3.4 | 4.1 | 4.3 |
| Sodium (dissolved) | mg/L | | | 5.87 | 3.36 | 3.81 | 4.10 | 5.87 | 5.73 | 3.50 | 3.81 | 3.92 |
| Sulfate | mg/L | | <500 | <3 | 4 | <3 | 5 | <3 | <3 | 4 | <3 | 7 |
| Anions | meq/L | | | 0.71 | 0.42 | 0.42 | 0.51 | 0.70 | 0.71 | 0.43 | 0.42 | 0.56 |
| Cations | meq/L | | | 0.70 | 0.35 | 0.41 | 0.47 | 0.70 | 0.68 | 0.37 | 0.42 | 0.46 |
| Ionic Balance | N/A | | | 0.98 | 0.83 | 0.97 | 0.92 | 0.99 | 0.97 | 0.87 | 1.00 | 0.83 |
| **Total Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 16.4 | 72.5 | 35.7 | 80.8 | 29.7 | 55.9 | 72.9 | 50.7 | 64.8 |
| Antimony | µg/L | | 6 | 0.053 | 0.006 | 0.006 | 0.010 | 0.009 | 0.050 | 0.006 | 0.006 | 0.006 |
| Arsenic | µg/L | 5 | 10 | 0.073 | 0.193 | 0.179 | 0.214 | 0.031 | 0.045 | 0.188 | 0.166 | 0.192 |
| Barium | µg/L | | 1000 | 2.29 | 2.55 | 2.00 | 2.74 | 2.13 | 2.99 | 2.52 | 2.06 | 2.46 |
| Beryllium | µg/L | | | 0.006 | <0.003 | 0.010 | 0.007 | 0.004 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | | | 0.007 | 0.004 | <0.001 | <0.001 | 0.002 | 0.002 | 0.002 | <0.001 | <0.001 |
| Boron | µg/L | | 5000 | 8.19 | 4.30 | 3.89 | 4.31 | 6.11 | 7.71 | 4.56 | 3.98 | 4.50 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.003 | 0.003 | 0.003 | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.15 | 0.31 | 0.24 | 0.45 | 0.11 | 0.15 | 0.31 | 0.31 | 0.35 |
| Cobalt | µg/L | | | 0.025 | 0.074 | 0.040 | 0.051 | 0.019 | 0.030 | 0.071 | 0.049 | 0.046 |
| Copper | µg/L | 2 - 4 | <1000 | 0.68 | 0.92 | 1.05 | 1.10 | 0.55 | 0.63 | 0.99 | 0.85 | 1.15 |
| Iron | µg/L | 300 | <300 | 14.2 | 153 | 90.9 | 130 | 22.6 | 51.6 | 153 | 98.7 | 120 |
| Lead | µg/L | 1 - 7 | 10 | 0.035 | 0.055 | 0.022 | 0.063 | <0.001 | <0.001 | 0.052 | 0.027 | 0.032 |
| Manganese | µg/L | | <50 | 1.4 | 11.5 | 6.2 | 6.0 | 3.0 | 10.2 | 12.6 | 6.8 | 6.1 |
| Mercury | ng/L | 26 | 1000 | <0.6 | 1.2 | <0.6 | 1.6 | <0.6 | <0.6 | 1.2 | 1.3 | 1.1 |
| Molybdenum | µg/L | 73 | | 0.045 | 0.047 | 0.042 | 0.048 | 0.036 | 0.017 | 0.038 | 0.042 | 0.047 |
| Nickel | µg/L | 25 - 150 | | 0.434 | 0.379 | 0.515 | 0.555 | 0.358 | 0.323 | 0.380 | 1.010 | 0.515 |
| Selenium | µg/L | 1 | 10 | 0.1 | 0.3 | 0.3 | 0.5 | 0.2 | 0.2 | 0.3 | <0.1 | 0.4 |
| Silver | µg/L | 0.1 | | 0.0131 | 0.0021 | 0.0015 | <0.0005 | 0.0077 | 0.0045 | 0.0029 | 0.0020 | <0.0005 |
| Strontium | µg/L | | | 18.9 | 10.1 | 11.7 | 12.6 | 18.6 | 18.8 | 10.5 | 11.5 | 12.5 |
| Thallium | µg/L | 0.8 | | 0.0015 | 0.0049 | 0.0025 | <0.0003 | 0.0015 | 0.0017 | 0.0042 | 0.0031 | <0.0003 |
| Tin | µg/L | | | 0.12 | <0.03 | <0.03 | <0.03 | 0.05 | 1.30 | <0.03 | 0.31 | 0.03 |
| Uranium | µg/L | | 20 | 0.0261 | 0.0229 | 0.0241 | 0.0288 | 0.0236 | 0.0207 | 0.0233 | 0.0243 | 0.0273 |
| Vanadium | µg/L | | | 0.035 | 0.215 | 0.132 | 0.203 | 0.064 | 0.065 | 0.214 | 0.161 | 0.154 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 1.04 | 2.54 | 3.14 | <0.1 | <0.1 | 1.20 | 0.94 | 1.03 |
| **Dissolved Metals** | | | | | | | | | | | | |
| Aluminum | µg/L | | | 5.6 | 15.7 | 13.1 | 15.5 | 7.8 | 11.8 | 15.3 | 12.9 | 14.8 |
| Antimony | µg/L | | | 0.052 | 0.005 | 0.006 | 0.010 | 0.009 | 0.049 | 0.006 | 0.005 | 0.006 |
| Arsenic | µg/L | | | <0.02 | 0.135 | 0.152 | 0.149 | <0.02 | <0.02 | 0.156 | 0.159 | 0.184 |
| Barium | µg/L | | | 2.22 | 1.77 | 1.62 | 1.79 | 1.87 | 2.40 | 1.76 | 1.63 | 1.71 |
| Beryllium | µg/L | | | 0.005 | <0.003 | 0.006 | 0.006 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 5.47 | 3.22 | 3.49 | 3.29 | 5.63 | 5.47 | 3.68 | 3.64 | 3.26 |
| Cadmium | µg/L | | | <0.002 | 0.002 | 0.003 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.15 | 0.18 | 0.24 | 0.42 | 0.10 | 0.13 | 0.21 | 0.24 | 0.34 |
| Cobalt | µg/L | | | 0.024 | 0.027 | 0.028 | 0.027 | 0.019 | 0.026 | 0.028 | 0.022 | 0.029 |
| Copper | µg/L | | | 0.67 | 0.83 | 1.04 | 0.94 | 0.55 | 0.63 | 0.81 | 0.84 | 0.97 |
| Iron | µg/L | | | 10.3 | 59.0 | 33.5 | 52.1 | 9.6 | 13.3 | 57.7 | 32.7 | 44.7 |
| Lead | µg/L | | | 0.029 | 0.015 | 0.019 | 0.013 | <0.001 | <0.001 | 0.013 | 0.010 | 0.009 |
| Manganese | µg/L | | | 1.0 | 6.6 | 0.9 | 0.6 | 2.6 | 8.3 | 7.7 | 0.9 | 0.6 |
| Molybdenum | µg/L | | | 0.045 | 0.045 | 0.041 | 0.047 | 0.035 | 0.017 | 0.026 | 0.041 | 0.046 |
| Nickel | µg/L | | | 0.430 | 0.372 | 0.514 | 0.454 | 0.354 | 0.321 | 0.334 | 0.922 | 0.473 |
| Selenium | µg/L | | | <0.04 | 0.2 | 0.2 | 0.3 | <0.04 | <0.04 | 0.1 | <0.1 | 0.3 |
| Silver | µg/L | | | 0.0130 | <0.0005 | <0.0005 | <0.0005 | 0.0040 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 18.7 | 10.0 | 11.6 | 11.7 | 18.4 | 18.3 | 9.9 | 11.4 | 11.6 |
| Uranium | µg/L | | | 0.0208 | 0.0188 | 0.0187 | 0.0220 | 0.0197 | 0.0156 | 0.0170 | 0.0191 | 0.0222 |
| Vanadium | µg/L | | | 0.035 | 0.095 | 0.106 | 0.145 | 0.062 | 0.050 | 0.078 | 0.077 | 0.109 |
| Zinc | µg/L | | | 0.07 | 1.04 | 2.51 | 0.95 | <0.05 | <0.05 | 0.90 | 0.94 | 0.89 |
| **Radionuclides** | | | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.05 | 0.02 | 0.03 | 0.04 | 0.07 | 0.07 | 0.02 | 0.03 | 0.03 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Aimaokatalok Outflow | | | | Fickle Duck Lake | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-Jun-08 | 19-Jul-08 | 13-Aug-08 | 15-Sep-08 | 18-Jul-08 | 14-Aug-08 | 9-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 8.6 | 7.9 | 8.5 | 9.3 | 13.8 | 21.3 | 24.9 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 12.9 | 10.1 | 11.2 | 13.2 | 16.3 | 25.0 | 30.7 |
| Specific Conductivity (lab) | µS/cm | | | 48.5 | 43.7 | 46.9 | 51.8 | 50.7 | 72.5 | 77.6 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.6 | 6.8 | 7.4 | 7.0 | 7.5 | 7.6 | 7.7 |
| Total Dissolved Solids | mg/L | | <500 | 23.4 | 20.8 | 23.3 | 24.7 | 25.2 | 36.4 | 37.4 |
| Total Suspended Solids | mg/L | | | 2 | <1 | <1 | <1 | 2 | 2 | 2 |
| True Colour | TCU | | <15 | **19** | **16** | 10 | **27** | **29** | **54** | **60** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 13 | 9 | 10 | 10 | 20 | 20 | 13 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.24 | 0.27 | 0.27 | 0.33 | 0.34 | 0.45 | 0.48 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.008 | 0.004 | 0.009 | 0.028 | 0.004 | 0.007 |
| Nitrite+Nitrate - N | mg/L | | | 0.018 | 0.007 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.017 | 0.007 | 0.004 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.25 | 0.22 | 0.37 | 0.38 | 0.41 | 0.48 | 0.21 |
| Dissolved Organic Carbon | mg/L | | | 5.3 | 4.4 | 5.0 | 5.5 | 5.0 | 9.8 | 9.8 |
| Total Organic Carbon | mg/L | | | 5.55 | 4.62 | 5.37 | 5.88 | 5.41 | 10.28 | 10.01 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | 2.26 | 2.07 | 1.51 |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 11 | 10 | 10 | 11 | 17 | 26 | 30 |
| Calcium (total) | mg/L | | | 2.55 | 1.98 | 2.30 | 2.45 | 4.60 | 7.05 | 8.59 |
| Calcium (extractable) | mg/L | | | 2.63 | 2.00 | 2.21 | 2.62 | 4.45 | 6.97 | 8.95 |
| Calcium (dissolved) | mg/L | | | 2.44 | 1.89 | 2.23 | 2.43 | 4.34 | 6.85 | 8.23 |
| Chloride | mg/L | | <250 | 7.4 | 6.8 | 7.6 | 8.1 | 5.7 | 7.1 | 5.5 |
| Magnesium (total) | mg/L | | | 1.40 | 1.29 | 1.45 | 1.63 | 1.33 | 1.79 | 1.94 |
| Magnesium (extractable) | mg/L | | | 1.55 | 1.25 | 1.37 | 1.62 | 1.25 | 1.84 | 2.04 |
| Magnesium (dissolved) | mg/L | | | 1.32 | 1.24 | 1.39 | 1.63 | 1.26 | 1.75 | 1.85 |
| Potassium (total) | mg/L | | | 0.757 | 0.634 | 0.673 | 0.602 | 0.443 | 0.433 | 0.542 |
| Potassium (extractable) | mg/L | | | 0.7 | 0.6 | 0.6 | 0.6 | 0.4 | 0.4 | 0.5 |
| Potassium (dissolved) | mg/L | | | 0.70 | 0.60 | 0.64 | 0.59 | 0.39 | 0.41 | 0.48 |
| Sodium (total) | mg/L | | | 3.67 | 3.56 | 4.15 | 4.13 | 3.29 | 3.83 | 3.35 |
| Sodium (extractable) | mg/L | | | 3.9 | 3.4 | 4.3 | 4.2 | 3.0 | 4.2 | 3.4 |
| Sodium (dissolved) | mg/L | | | 3.61 | 3.50 | 4.06 | 4.09 | 3.19 | 3.79 | 3.22 |
| Sulfate | mg/L | | <500 | <3 | <3 | <3 | <3 | <3 | 3 | <3 |
| Anions | meq/L | | | 0.43 | 0.39 | 0.43 | 0.46 | 0.48 | 0.69 | 0.70 |
| Cations | meq/L | | | 0.45 | 0.37 | 0.43 | 0.46 | 0.47 | 0.69 | 0.78 |
| Ionic Balance | N/A | | | 1.05 | 0.94 | 1.00 | 1.00 | 0.98 | 0.99 | 1.11 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **122** | 55.1 | 46.4 | 68.7 | **126** | **153** | **142** |
| Antimony | µg/L | | 6 | 0.005 | 0.009 | 0.006 | 0.007 | 0.007 | 0.010 | 0.007 |
| Arsenic | µg/L | 5 | 10 | 0.175 | 0.140 | 0.167 | 0.177 | 0.235 | 0.283 | 0.231 |
| Barium | µg/L | | 1000 | 3.30 | 2.56 | 2.05 | 2.52 | 4.42 | 6.20 | 6.28 |
| Beryllium | µg/L | | | 0.006 | 0.009 | 0.004 | 0.003 | 0.005 | 0.010 | 0.006 |
| Bismuth | µg/L | | | <0.001 | <0.001 | <0.001 | 0.002 | 0.005 | 0.004 | 0.004 |
| Boron | µg/L | | 5000 | 4.53 | 3.60 | 4.15 | 3.99 | 4.21 | 3.77 | 3.55 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.002 | <0.002 | 0.002 | 0.003 | 0.006 | 0.004 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.29 | 0.30 | 0.21 | 0.27 | 0.43 | 0.63 | 0.61 |
| Cobalt | µg/L | | | 0.129 | 0.080 | 0.040 | 0.062 | 0.066 | 0.100 | 0.088 |
| Copper | µg/L | 2 - 4 | <1000 | 0.78 | 0.88 | 0.94 | 1.22 | 1.48 | 1.83 | 1.90 |
| Iron | µg/L | 300 | <300 | 214 | 145 | 94.0 | 123 | **401** | **371** | 228 |
| Lead | µg/L | 1 - 7 | 10 | 0.054 | 0.046 | 0.020 | 0.021 | 0.104 | 0.088 | 0.052 |
| Manganese | µg/L | | <50 | 15.9 | 13.1 | 6.6 | 7.5 | 3.6 | 5.0 | 2.3 |
| Mercury | ng/L | 26 | 1000 | 1.5 | 1.7 | 1.7 | <0.6 | 1.4 | 1.2 | 1.7 |
| Molybdenum | µg/L | 73 | | 0.034 | 0.030 | 0.047 | 0.066 | 0.065 | 0.083 | 0.081 |
| Nickel | µg/L | 25 - 150 | | 0.450 | 0.427 | 0.383 | 0.482 | 0.689 | 1.160 | 1.070 |
| Selenium | µg/L | 1 | 10 | 0.2 | 0.2 | 0.2 | <0.1 | 0.3 | 0.3 | <0.1 |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | 0.0023 | 0.0047 | 0.0137 | 0.0038 | 0.0012 |
| Strontium | µg/L | | | 11.5 | 10.4 | 11.7 | 12.3 | 18.9 | 27.6 | 27.1 |
| Thallium | µg/L | 0.8 | | <0.0003 | <0.0003 | 0.0017 | 0.0020 | 0.0040 | 0.0052 | 0.0037 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0222 | 0.0224 | 0.0235 | 0.0298 | 0.0344 | 0.0454 | 0.0359 |
| Vanadium | µg/L | | | 0.278 | 0.252 | 0.149 | 0.149 | 0.425 | 0.526 | 0.379 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.15 | 1.62 | 0.52 | 0.72 | 0.90 | 1.49 | 1.27 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 10.3 | 14.9 | 14.1 | 17.3 | 39.8 | 36.1 | 36.0 |
| Antimony | µg/L | | | 0.005 | 0.009 | 0.006 | 0.007 | 0.007 | 0.010 | 0.007 |
| Arsenic | µg/L | | | 0.152 | 0.128 | 0.162 | 0.165 | 0.208 | 0.275 | 0.188 |
| Barium | µg/L | | | 1.99 | 1.87 | 1.63 | 1.83 | 3.37 | 4.74 | 4.85 |
| Beryllium | µg/L | | | <0.003 | 0.007 | 0.004 | 0.003 | 0.004 | 0.003 | 0.006 |
| Boron | µg/L | | | 3.89 | 3.23 | 3.76 | 3.38 | 4.04 | 3.73 | 2.99 |
| Cadmium | µg/L | | | 0.002 | <0.002 | <0.002 | 0.002 | 0.002 | 0.003 | <0.002 |
| Chromium | µg/L | | | 0.16 | 0.27 | 0.19 | 0.26 | 0.32 | 0.55 | 0.54 |
| Cobalt | µg/L | | | 0.081 | 0.032 | 0.022 | 0.027 | 0.024 | 0.049 | 0.065 |
| Copper | µg/L | | | 0.77 | 0.87 | 0.93 | 0.94 | 1.24 | 1.81 | 1.75 |
| Iron | µg/L | | | 40.1 | 58.8 | 31.7 | 44.9 | 190.0 | 169.0 | 122.0 |
| Lead | µg/L | | | 0.012 | 0.007 | 0.016 | 0.005 | 0.045 | 0.046 | 0.019 |
| Manganese | µg/L | | | 10.0 | 7.8 | 0.7 | 1.1 | 0.5 | 0.6 | 1.0 |
| Molybdenum | µg/L | | | 0.030 | 0.025 | 0.046 | 0.049 | 0.061 | 0.076 | 0.081 |
| Nickel | µg/L | | | 0.336 | 0.362 | 0.351 | 0.462 | 0.582 | 1.150 | 1.000 |
| Selenium | µg/L | | | <0.1 | 0.2 | 0.1 | <0.1 | 0.2 | 0.3 | <0.1 |
| Silver | µg/L | | | <0.0005 | <0.0005 | 0.0006 | 0.0019 | 0.0018 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 11.4 | 10.0 | 11.6 | 12.2 | 17.7 | 27.0 | 25.7 |
| Uranium | µg/L | | | 0.0154 | 0.0180 | 0.0183 | 0.0254 | 0.0255 | 0.0380 | 0.0322 |
| Vanadium | µg/L | | | 0.063 | 0.120 | 0.084 | 0.094 | 0.192 | 0.293 | 0.220 |
| Zinc | µg/L | | | 1.14 | 0.98 | 0.52 | 0.68 | 0.57 | 1.48 | 0.88 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.04 | 0.03 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | 0.001 | 0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Fickle Duck Outflow | | | | Koignuk River | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 26-Jun-08 | 18-Jul-08 | 14-Aug-08 | 15-Sep-08 | 23-Jun-08 | 17-Jul-08 | 19-Aug-08 | 14-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 12.3 | 14.7 | 21.1 | 24.9 | 10.5 | 10.8 | 11.3 | 12.7 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 14.5 | 16.8 | 25.8 | 30.7 | 15.9 | 12.7 | 16.2 | 17.5 |
| Specific Conductivity (lab) | µS/cm | | | 39.8 | 55.9 | 74.5 | 78.2 | 57.1 | 56.2 | 60.7 | 68.8 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | **6.4** | 6.9 | 7.3 | 7.3 | 7.1 | 7.3 | 7.8 | 8.0 |
| Total Dissolved Solids | mg/L | | <500 | 26.7 | 27.0 | 36.3 | 37.6 | 31.9 | 28.2 | 28.9 | 34.2 |
| Total Suspended Solids | mg/L | | | 4 | 1 | 4 | 2 | 23 | 3 | 2 | 3 |
| True Colour | TCU | | <15 | **38** | **29** | **54** | **60** | **28** | 11 | **16** | **28** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 17 | 21 | 19 | 20 | 36 | 14 | 14 | 15 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.31 | 0.34 | 0.45 | 0.49 | 0.34 | 0.36 | 0.27 | 0.35 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.014 | 0.012 | 0.008 | 0.012 | 0.008 | 0.012 | 0.004 | 0.010 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 0.006 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | 0.001 | 0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | 0.006 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.32 | 0.49 | 0.62 | 0.61 | 0.55 | 0.32 | 0.37 | 0.53 |
| Dissolved Organic Carbon | mg/L | | | 5.7 | 5.3 | 11.5 | 9.7 | 5.6 | 4.3 | 5.0 | 6.0 |
| Total Organic Carbon | mg/L | | | 6.02 | 5.79 | 12.12 | 10.31 | 6.15 | 4.62 | 5.37 | 6.53 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 15 | 18 | 26 | 30 | 13 | 13 | 14 | 15 |
| Calcium (total) | mg/L | | | 4.06 | 5.00 | 7.01 | 8.43 | 3.28 | 2.65 | 3.17 | 3.60 |
| Calcium (extractable) | mg/L | | | 4.04 | 4.65 | 7.16 | 8.87 | 3.12 | 2.61 | 3.20 | 3.68 |
| Calcium (dissolved) | mg/L | | | 3.88 | 4.76 | 6.84 | 7.86 | 2.97 | 2.55 | 3.03 | 3.29 |
| Chloride | mg/L | | <250 | 3.4 | 6.5 | 7.8 | 5.6 | 9.1 | 8.8 | 9.7 | 10.5 |
| Magnesium (total) | mg/L | | | 1.05 | 1.46 | 1.83 | 2.17 | 1.95 | 1.54 | 2.00 | 2.18 |
| Magnesium (extractable) | mg/L | | | 1.08 | 1.26 | 1.92 | 2.07 | 1.97 | 1.50 | 2.00 | 2.03 |
| Magnesium (dissolved) | mg/L | | | 0.95 | 1.38 | 1.78 | 1.98 | 1.58 | 1.45 | 1.86 | 1.95 |
| Potassium (total) | mg/L | | | 0.592 | 0.411 | 0.420 | 0.649 | 1.320 | 0.740 | 0.741 | 0.835 |
| Potassium (extractable) | mg/L | | | 0.5 | 0.4 | 0.4 | 0.5 | 0.7 | 0.7 | 0.6 | 0.7 |
| Potassium (dissolved) | mg/L | | | 0.47 | 0.37 | 0.39 | 0.50 | 0.79 | 0.65 | 0.63 | 0.66 |
| Sodium (total) | mg/L | | | 1.97 | 3.61 | 4.05 | 3.53 | 4.64 | 4.27 | 5.12 | 6.16 |
| Sodium (extractable) | mg/L | | | 2.3 | 3.3 | 4.4 | 3.6 | 4.8 | 4.4 | 4.6 | 5.5 |
| Sodium (dissolved) | mg/L | | | 1.91 | 3.49 | 4.03 | 3.29 | 4.50 | 4.23 | 4.99 | 5.76 |
| Sulfate | mg/L | | <500 | 8 | <3 | <3 | <3 | 6 | 4 | <3 | 4 |
| Anions | meq/L | | | 0.51 | 0.52 | 0.68 | 0.70 | 0.59 | 0.54 | 0.54 | 0.64 |
| Cations | meq/L | | | 0.40 | 0.49 | 0.72 | 0.78 | 0.54 | 0.46 | 0.54 | 0.61 |
| Ionic Balance | N/A | | | 0.79 | 0.94 | 1.05 | 1.12 | 0.92 | 0.86 | 0.99 | 0.96 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **327** | 88.9 | **108** | **328** | **1360** | **238** | **297** | **353** |
| Antimony | µg/L | | 6 | 0.006 | 0.008 | 0.010 | 0.010 | 0.010 | 0.009 | 0.012 | 0.040 |
| Arsenic | µg/L | 5 | 10 | 0.173 | 0.252 | 0.271 | 0.229 | 0.359 | 0.228 | 0.272 | 0.266 |
| Barium | µg/L | | 1000 | 6.08 | 4.18 | 5.44 | 8.54 | 17.60 | 4.33 | 4.90 | 6.06 |
| Beryllium | µg/L | | | 0.015 | 0.006 | 0.011 | 0.021 | 0.041 | 0.008 | 0.010 | 0.016 |
| Bismuth | µg/L | | | 0.004 | 0.004 | 0.003 | 0.003 | 0.009 | 0.002 | 0.002 | 0.003 |
| Boron | µg/L | | 5000 | 4.72 | 4.25 | 3.89 | 3.55 | 6.43 | 5.14 | 6.47 | 5.37 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.003 | 0.002 | 0.003 | 0.004 | 0.004 | 0.002 | <0.002 | **0.165** |
| Chromium | µg/L | 1 or 16 | 50 | 0.60 | 0.38 | 0.50 | 0.80 | **2.15** | 0.47 | 0.57 | **3.08** |
| Cobalt | µg/L | | | 0.128 | 0.134 | 0.109 | 0.169 | 0.498 | 0.096 | 0.119 | 0.249 |
| Copper | µg/L | 2 - 4 | <1000 | 1.18 | 1.21 | 1.75 | **2.33** | 1.92 | 1.11 | 1.29 | 1.89 |
| Iron | µg/L | 300 | <300 | **509** | **505** | **366** | **540** | **1160** | 256 | 290 | **315** |
| Lead | µg/L | 1 - 7 | 10 | 0.110 | 0.049 | 0.057 | 0.106 | 0.481 | 0.097 | 0.111 | 0.256 |
| Manganese | µg/L | | <50 | 6.0 | 7.9 | 6.1 | 7.1 | 23.5 | 7.0 | 10.2 | 26.9 |
| Mercury | ng/L | 26 | 1000 | 2.1 | 0.7 | 1.5 | 1.0 | 1.7 | 0.8 | 1.1 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.074 | 0.060 | 0.086 | 0.085 | 0.074 | 0.048 | 0.140 | 0.080 |
| Nickel | µg/L | 25 - 150 | | 0.780 | 0.745 | 1.050 | 1.170 | 1.670 | 0.538 | 0.479 | 1.250 |
| Selenium | µg/L | 1 | 10 | 0.2 | 0.3 | 0.3 | <0.1 | <0.1 | 0.1 | 0.3 | <0.1 |
| Silver | µg/L | 0.1 | | 0.0008 | 0.0120 | 0.0027 | 0.0052 | 0.0032 | 0.0023 | 0.0017 | 0.0072 |
| Strontium | µg/L | | | 14.1 | 20.4 | 27.5 | 28.0 | 17.6 | 13.2 | 15.5 | 16.5 |
| Thallium | µg/L | 0.8 | | 0.0038 | 0.0035 | 0.0036 | 0.0046 | 0.0172 | 0.0041 | 0.0046 | 0.0043 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | 0.06 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0331 | 0.0312 | 0.0410 | 0.0457 | 0.0911 | 0.0322 | 0.0407 | 0.0434 |
| Vanadium | µg/L | | | 0.628 | 0.346 | 0.405 | 0.695 | 2.350 | 0.446 | 0.512 | 0.540 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.52 | 0.83 | 0.72 | 1.99 | 3.34 | 2.09 | 2.27 | 18.00 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 60.4 | 33.7 | 34.5 | 32.0 | 77.9 | 24.9 | 35.3 | 32.8 |
| Antimony | µg/L | | | 0.006 | 0.008 | 0.010 | 0.010 | 0.010 | 0.008 | 0.012 | 0.039 |
| Arsenic | µg/L | | | 0.130 | 0.237 | 0.263 | 0.167 | 0.194 | 0.198 | 0.263 | 0.213 |
| Barium | µg/L | | | 3.13 | 3.47 | 4.44 | 4.69 | 2.29 | 1.84 | 1.83 | 2.17 |
| Beryllium | µg/L | | | 0.004 | 0.006 | <0.003 | 0.004 | <0.003 | <0.003 | 0.005 | 0.008 |
| Boron | µg/L | | | 3.37 | 3.84 | 3.68 | 2.38 | 4.80 | 4.51 | 5.69 | 3.88 |
| Cadmium | µg/L | | | 0.003 | 0.002 | <0.002 | 0.002 | 0.002 | <0.002 | <0.002 | 0.126 |
| Chromium | µg/L | | | 0.23 | 0.32 | 0.49 | 0.45 | 0.27 | 0.21 | 0.21 | 1.24 |
| Cobalt | µg/L | | | 0.052 | 0.033 | 0.049 | 0.058 | 0.052 | 0.023 | 0.028 | 0.123 |
| Copper | µg/L | | | 1.17 | 1.18 | 1.73 | 1.65 | 1.90 | 1.00 | 1.28 | 1.40 |
| Iron | µg/L | | | 162.0 | 264.0 | 207.0 | 126.0 | 128.0 | 78.5 | 67.8 | 57.3 |
| Lead | µg/L | | | 0.046 | 0.026 | 0.035 | 0.013 | 0.055 | 0.022 | 0.021 | 0.047 |
| Manganese | µg/L | | | 2.6 | 0.9 | 1.2 | 1.3 | 3.2 | 2.5 | 0.7 | 18.5 |
| Molybdenum | µg/L | | | 0.056 | 0.059 | 0.083 | 0.070 | 0.055 | 0.048 | 0.062 | 0.066 |
| Nickel | µg/L | | | 0.573 | 0.653 | 1.030 | 0.953 | 0.562 | 0.347 | 0.285 | 0.912 |
| Selenium | µg/L | | | 0.2 | 0.2 | 0.2 | <0.1 | <0.1 | 0.1 | 0.3 | <0.1 |
| Silver | µg/L | | | <0.0005 | 0.0036 | 0.0005 | 0.0019 | <0.0005 | 0.0014 | <0.0005 | 0.0023 |
| Strontium | µg/L | | | 13.0 | 19.4 | 27.4 | 25.4 | 13.2 | 12.3 | 15.0 | 14.3 |
| Uranium | µg/L | | | 0.0227 | 0.0247 | 0.0377 | 0.0328 | 0.0353 | 0.0222 | 0.0255 | 0.0285 |
| Vanadium | µg/L | | | 0.197 | 0.200 | 0.267 | 0.187 | 0.259 | 0.155 | 0.092 | 0.108 |
| Zinc | µg/L | | | 1.50 | 0.73 | 0.71 | 1.14 | 1.42 | 0.64 | 2.25 | 14.30 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | 0.008 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.02 | 0.03 | 0.04 | 0.04 | 0.02 | 0.03 | 0.03 | 0.03 |
| Sulphide | mg/L | | | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Reference Lake | | | Reference Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 18-Jul-08 | 15-Aug-08 | 9-Sep-08 | 24-Jun-08 | 18-Jul-08 | 15-Aug-08 | 9-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 10.1 | 15.3 | 15.5 | 7.1 | 10.7 | 14.4 | 15.7 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 10.7 | 18.2 | 20.2 | 9.1 | 11.4 | 16.8 | 20.2 |
| Specific Conductivity (lab) | µS/cm | | | 34.6 | 53.2 | 61 | 27.8 | 36.3 | 49.5 | 60.6 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.5 | 7.5 | 7.7 | 6.7 | 7.0 | 7.5 | 7.1 |
| Total Dissolved Solids | mg/L | | <500 | 17.8 | 26.3 | 30.9 | 17.9 | 18.2 | 24.9 | 30.3 |
| Total Suspended Solids | mg/L | | | 2 | 2 | 1 | 3 | 5 | 2 | <1 |
| True Colour | TCU | | <15 | **16** | **34** | **39** | **19** | **16** | **26** | **39** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 15 | 14 | 10 | 19 | 16 | 16 | 9 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.27 | 0.39 | 0.40 | 0.29 | 0.31 | 0.38 | 0.38 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.005 | 0.006 | 0.004 | 0.009 | 0.012 | 0.004 | 0.005 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 | 0.022 |
| Nitrite - N | mg/L | 0.06 | 3.2 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | 0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | 0.006 | <0.005 | <0.005 | <0.005 | 0.022 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.41 | 0.54 | 0.30 | 0.22 | 0.55 | 0.50 | 0.24 |
| Dissolved Organic Carbon | mg/L | | | 4.1 | 7.4 | 7.4 | 5.7 | 4.3 | 7.1 | 7.5 |
| Total Organic Carbon | mg/L | | | 4.51 | 7.94 | 7.70 | 5.92 | 4.85 | 7.60 | 7.74 |
| Chlorophyll *a* | µg/L | | | 1.98 | 2.28 | 10.24 | - | - | - | - |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 12 | 19 | 19 | 9 | 13 | 17 | 19 |
| Calcium (total) | mg/L | | | 2.79 | 4.91 | 5.45 | 2.25 | 2.93 | 4.36 | 5.48 |
| Calcium (extractable) | mg/L | | | 2.77 | 4.87 | 5.42 | 2.21 | 2.97 | 4.45 | 5.42 |
| Calcium (dissolved) | mg/L | | | 2.60 | 4.64 | 5.17 | 2.11 | 2.84 | 4.21 | 5.15 |
| Chloride | mg/L | | <250 | 3.5 | 5.0 | 6.7 | 3.3 | 3.4 | 4.8 | 6.4 |
| Magnesium (total) | mg/L | | | 0.96 | 1.46 | 1.64 | 0.84 | 1.00 | 1.35 | 1.64 |
| Magnesium (extractable) | mg/L | | | 0.92 | 1.46 | 1.61 | 0.86 | 0.98 | 1.39 | 1.61 |
| Magnesium (dissolved) | mg/L | | | 0.89 | 1.40 | 1.55 | 0.74 | 0.97 | 1.30 | 1.55 |
| Potassium (total) | mg/L | | | 0.382 | 0.398 | 0.479 | 0.526 | 0.390 | 0.389 | 0.479 |
| Potassium (extractable) | mg/L | | | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 | 0.4 |
| Potassium (dissolved) | mg/L | | | 0.34 | 0.37 | 0.44 | 0.42 | 0.35 | 0.36 | 0.45 |
| Sodium (total) | mg/L | | | 2.24 | 3.21 | 3.86 | 1.90 | 2.21 | 3.12 | 3.80 |
| Sodium (extractable) | mg/L | | | 2.1 | 3.4 | 3.9 | 2.3 | 2.1 | 3.2 | 3.8 |
| Sodium (dissolved) | mg/L | | | 2.15 | 3.19 | 3.67 | 1.89 | 2.20 | 3.04 | 3.62 |
| Sulfate | mg/L | | <500 | <3 | <3 | 4 | 5 | <3 | <3 | 3 |
| Anions | meq/L | | | 0.34 | 0.49 | 0.58 | 0.33 | 0.35 | 0.47 | 0.56 |
| Cations | meq/L | | | 0.32 | 0.52 | 0.58 | 0.29 | 0.33 | 0.49 | 0.58 |
| Ionic Balance | N/A | | | 0.92 | 1.06 | 1.01 | 0.88 | 0.93 | 1.04 | 1.03 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 89.5 | 71.4 | 71.9 | **290** | 99.9 | 58.1 | 63.5 |
| Antimony | µg/L | | 6 | 0.008 | 0.011 | 0.010 | 0.017 | 0.006 | 0.010 | 0.010 |
| Arsenic | µg/L | 5 | 10 | 0.202 | 0.269 | 0.212 | 0.172 | 0.224 | 0.240 | 0.209 |
| Barium | µg/L | | 1000 | 3.03 | 3.74 | 3.67 | 4.73 | 3.29 | 3.13 | 3.55 |
| Beryllium | µg/L | | | <0.003 | 0.012 | 0.004 | 0.008 | 0.014 | 0.004 | 0.004 |
| Bismuth | µg/L | | | <0.001 | 0.002 | <0.001 | 0.012 | <0.001 | 0.002 | <0.001 |
| Boron | µg/L | | 5000 | 3.74 | 5.04 | 4.10 | 3.95 | 3.72 | 4.82 | 3.55 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.005 | 0.005 | 0.002 | 0.004 | 0.002 | 0.004 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.39 | 0.38 | 0.42 | 0.53 | 0.40 | 0.29 | 0.39 |
| Cobalt | µg/L | | | 0.066 | 0.092 | 0.078 | 0.125 | 0.126 | 0.068 | 0.081 |
| Copper | µg/L | 2 - 4 | <1000 | 1.33 | 1.57 | 1.68 | 1.07 | 1.25 | 1.43 | 1.73 |
| Iron | µg/L | 300 | <300 | 256 | 292 | 171 | **350** | **366** | 246 | 158 |
| Lead | µg/L | 1 - 7 | 10 | 0.092 | 0.042 | 0.025 | 0.115 | 0.051 | 0.033 | 0.028 |
| Manganese | µg/L | | <50 | 4.3 | 5.7 | 3.8 | 5.9 | 13.1 | 5.8 | 4.0 |
| Mercury | ng/L | 26 | 1000 | 2.2 | 3.0 | 1.5 | 1.9 | 2.0 | 2.0 | 0.7 |
| Molybdenum | µg/L | 73 | | 0.045 | 0.058 | 0.055 | 0.049 | 0.039 | 0.053 | 0.052 |
| Nickel | µg/L | 25 - 150 | | 0.463 | 0.762 | 0.658 | 0.468 | 0.502 | 0.621 | 0.633 |
| Selenium | µg/L | 1 | 10 | 0.3 | 0.3 | 0.3 | <0.1 | 0.2 | 0.2 | 0.3 |
| Silver | µg/L | 0.1 | | <0.0005 | 0.0019 | <0.0005 | 0.0033 | <0.0005 | 0.0012 | <0.0005 |
| Strontium | µg/L | | | 8.6 | 13.1 | 13.9 | 7.3 | 9.2 | 11.9 | 13.7 |
| Thallium | µg/L | 0.8 | | <0.0003 | 0.0026 | <0.0003 | 0.0049 | <0.0003 | 0.0020 | <0.0003 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | 0.15 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0299 | 0.0306 | 0.0292 | 0.0283 | 0.0308 | 0.0295 | 0.0281 |
| Vanadium | µg/L | | | 0.392 | 0.270 | 0.227 | 0.583 | 0.373 | 0.227 | 0.208 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 0.81 | 1.12 | 2.16 | 1.48 | 0.71 | 1.66 | 1.74 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 19.4 | 23.8 | 23.8 | 7.8 | 18.7 | 17.9 | 23.5 |
| Antimony | µg/L | | | 0.008 | 0.011 | 0.010 | 0.017 | 0.006 | 0.009 | 0.010 |
| Arsenic | µg/L | | | 0.164 | 0.266 | 0.162 | 0.132 | 0.195 | 0.237 | 0.180 |
| Barium | µg/L | | | 2.10 | 3.01 | 3.01 | 1.73 | 2.22 | 2.54 | 2.96 |
| Beryllium | µg/L | | | <0.003 | 0.005 | 0.004 | <0.003 | 0.005 | 0.004 | 0.004 |
| Boron | µg/L | | | 3.32 | 4.47 | 2.94 | 3.06 | 3.47 | 4.38 | 2.91 |
| Cadmium | µg/L | | | <0.002 | 0.003 | <0.002 | 0.002 | <0.002 | 0.003 | <0.002 |
| Chromium | µg/L | | | 0.27 | 0.37 | 0.38 | 0.11 | 0.35 | 0.28 | 0.37 |
| Cobalt | µg/L | | | 0.020 | 0.035 | 0.042 | 0.062 | 0.023 | 0.031 | 0.044 |
| Copper | µg/L | | | 1.13 | 1.55 | 1.52 | 1.06 | 1.09 | 1.42 | 1.51 |
| Iron | µg/L | | | 89.0 | 144.0 | 75.2 | 52.2 | 131.0 | 123.0 | 79.1 |
| Lead | µg/L | | | 0.017 | 0.022 | 0.007 | 0.021 | 0.009 | 0.020 | 0.011 |
| Manganese | µg/L | | | 0.2 | 0.5 | 0.7 | 3.8 | 0.4 | 0.4 | 1.2 |
| Molybdenum | µg/L | | | 0.034 | 0.053 | 0.054 | 0.043 | 0.038 | 0.053 | 0.052 |
| Nickel | µg/L | | | 0.386 | 0.712 | 0.583 | 0.345 | 0.396 | 0.551 | 0.630 |
| Selenium | µg/L | | | <0.1 | 0.3 | 0.2 | <0.1 | 0.2 | 0.1 | 0.2 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 8.1 | 12.8 | 13.0 | 7.2 | 8.7 | 11.6 | 13.1 |
| Uranium | µg/L | | | 0.0217 | 0.0272 | 0.0249 | 0.0171 | 0.0221 | 0.0255 | 0.0240 |
| Vanadium | µg/L | | | 0.156 | 0.155 | 0.143 | 0.154 | 0.205 | 0.163 | 0.127 |
| Zinc | µg/L | | | 0.45 | 1.11 | 0.89 | 1.47 | 0.39 | 1.64 | 1.05 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | 0.007 | 0.007 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.03 | 0.03 | 0.03 | 0.02 | 0.03 | 0.03 | 0.03 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Stickleback Lake | | | Stickleback Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 18-Jul-08 | 14-Aug-08 | 9-Sep-08 | 26-Jun-08 | 18-Jul-08 | 14-Aug-08 | 9-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 31.7 | 32.4 | 32.1 | 11.1 | 31.6 | 32.4 | 32.0 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 63.4 | 66.0 | 74.1 | 21.4 | 63.0 | 68.4 | 74.7 |
| Specific Conductivity (lab) | µS/cm | | | 224 | 232 | 240 | 71.5 | 223 | 238 | 242 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.7 | 7.9 | 7.7 | 6.7 | 7.4 | 7.4 | 7.9 |
| Total Dissolved Solids | mg/L | | <500 | 105.0 | 110.0 | 115.0 | 36.1 | 105.0 | 113.0 | 115.0 |
| Total Suspended Solids | mg/L | | | <1 | <1 | <1 | <1 | 1 | 1 | 3 |
| True Colour | TCU | | <15 | <1 | <1 | 12 | 11 | <1 | <1 | 7 |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 7 | 13 | 12 | 16 | 10 | 11 | 16 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.28 | 0.33 | 0.37 | 0.17 | 0.32 | 0.33 | 0.40 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.007 | 0.006 | 0.005 | 0.004 | 0.013 | 0.006 | 0.009 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | 0.006 | 0.006 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | 0.006 | 0.006 | <0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.21 | 0.38 | 0.25 | 0.10 | 0.33 | 0.45 | 0.53 |
| Dissolved Organic Carbon | mg/L | | | 3.8 | 5.1 | 4.9 | 2.5 | 3.8 | 5.4 | 4.9 |
| Total Organic Carbon | mg/L | | | 4.01 | 5.48 | 5.15 | 2.60 | 4.13 | 5.85 | 5.43 |
| Chlorophyll *a* | µg/L | | | 1.70 | 1.15 | 1.76 | - | - | - | - |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 39 | 39 | 39 | 14 | 39 | 39 | 39 |
| Calcium (total) | mg/L | | | 16.30 | 16.10 | 17.80 | 5.17 | 16.30 | 16.50 | 17.00 |
| Calcium (extractable) | mg/L | | | 16.00 | 16.30 | 19.10 | 5.33 | 15.80 | 16.90 | 19.20 |
| Calcium (dissolved) | mg/L | | | 16.10 | 15.60 | 17.00 | 4.97 | 15.70 | 15.30 | 16.90 |
| Chloride | mg/L | | <250 | 47.2 | 50.0 | 52.0 | 13.9 | 47.6 | 51.4 | 52.1 |
| Magnesium (total) | mg/L | | | 6.20 | 6.03 | 6.72 | 1.85 | 6.18 | 6.17 | 6.35 |
| Magnesium (extractable) | mg/L | | | 5.70 | 6.15 | 6.41 | 1.96 | 5.73 | 6.37 | 6.49 |
| Magnesium (dissolved) | mg/L | | | 6.11 | 5.87 | 6.40 | 1.76 | 5.98 | 5.77 | 6.29 |
| Potassium (total) | mg/L | | | 1.750 | 1.670 | 1.760 | 0.699 | 1.740 | 1.700 | 1.670 |
| Potassium (extractable) | mg/L | | | 1.6 | 1.6 | 1.6 | 0.6 | 1.6 | 1.6 | 1.6 |
| Potassium (dissolved) | mg/L | | | 1.71 | 1.62 | 1.66 | 0.67 | 1.68 | 1.58 | 1.65 |
| Sodium (total) | mg/L | | | 14.90 | 14.10 | 15.60 | 4.29 | 14.80 | 14.70 | 14.90 |
| Sodium (extractable) | mg/L | | | 13.5 | 14.6 | 14.4 | 4.4 | 13.6 | 15.1 | 14.7 |
| Sodium (dissolved) | mg/L | | | 14.60 | 13.60 | 14.80 | 4.17 | 14.40 | 13.50 | 14.80 |
| Sulfate | mg/L | | <500 | <3 | <3 | <3 | 3 | <3 | <3 | <3 |
| Anions | meq/L | | | 2.01 | 2.10 | 2.15 | 0.68 | 2.02 | 2.14 | 2.15 |
| Cations | meq/L | | | 1.89 | 2.00 | 2.15 | 0.64 | 1.89 | 2.06 | 2.17 |
| Ionic Balance | N/A | | | 0.94 | 0.95 | 1.00 | 0.94 | 0.94 | 0.96 | 1.01 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 18.6 | 15.7 | 27.1 | 28.3 | 13.2 | 17.5 | 62.0 |
| Antimony | µg/L | | 6 | 0.007 | 0.006 | 0.007 | 0.005 | 0.006 | 0.007 | 0.008 |
| Arsenic | µg/L | 5 | 10 | 0.418 | 0.517 | 0.426 | 0.168 | 0.395 | 0.478 | 0.425 |
| Barium | µg/L | | 1000 | 6.35 | 5.80 | 5.85 | 2.73 | 6.11 | 6.21 | 6.04 |
| Beryllium | µg/L | | | <0.003 | 0.007 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | | | 0.017 | 0.002 | <0.001 | 0.001 | 0.007 | 0.002 | 0.009 |
| Boron | µg/L | | 5000 | 15.50 | 16.10 | 16.70 | 5.50 | 15.10 | 16.40 | 17.10 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.005 | <0.002 | <0.002 | 0.003 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.08 | 0.27 | 0.18 | 0.10 | 0.09 | 0.22 | 0.20 |
| Cobalt | µg/L | | | 0.049 | 0.036 | 0.042 | 0.063 | 0.045 | 0.071 | 0.081 |
| Copper | µg/L | 2 - 4 | <1000 | 0.35 | 0.34 | 0.45 | 0.09 | 0.31 | 0.35 | 0.47 |
| Iron | µg/L | 300 | <300 | 110 | 93.9 | 45.4 | 119 | 83.5 | 126 | 193 |
| Lead | µg/L | 1 - 7 | 10 | 0.030 | 0.004 | 0.025 | 0.023 | 0.007 | 0.007 | 0.025 |
| Manganese | µg/L | | <50 | 22.1 | 7.2 | 6.5 | 43.3 | 14.6 | 20.4 | 19.4 |
| Mercury | ng/L | 26 | 1000 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.028 | 0.047 | 0.035 | 0.015 | 0.030 | 0.048 | 0.041 |
| Nickel | µg/L | 25 - 150 | | 0.119 | 0.323 | 0.177 | 0.115 | 0.187 | 0.329 | 0.245 |
| Selenium | µg/L | 1 | 10 | 0.6 | 0.6 | 0.7 | 0.2 | 0.6 | 0.8 | 0.4 |
| Silver | µg/L | 0.1 | | 0.0013 | 0.0038 | <0.0005 | 0.0024 | 0.0036 | 0.0029 | <0.0005 |
| Strontium | µg/L | | | 90.1 | 93.6 | 96.1 | 28.1 | 89.6 | 96.6 | 95.5 |
| Thallium | µg/L | 0.8 | | 0.0071 | 0.0061 | 0.0010 | <0.0003 | 0.0044 | 0.0047 | 0.0076 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0088 | 0.0097 | 0.0095 | 0.0061 | 0.0085 | 0.0119 | 0.0132 |
| Vanadium | µg/L | | | 0.013 | 0.052 | 0.069 | 0.056 | 0.014 | 0.068 | 0.126 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.33 | 0.81 | 0.57 | 0.99 | 0.34 | <0.1 | 0.26 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 1.2 | 1.2 | 1.4 | 6.9 | 1.8 | 2.1 | 2.7 |
| Antimony | µg/L | | | 0.007 | 0.005 | 0.007 | 0.005 | 0.005 | 0.007 | 0.007 |
| Arsenic | µg/L | | | 0.293 | 0.385 | 0.347 | 0.139 | 0.328 | 0.382 | 0.363 |
| Barium | µg/L | | | 5.88 | 5.41 | 5.25 | 2.28 | 5.64 | 5.38 | 5.21 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 14.40 | 14.90 | 14.70 | 4.78 | 14.40 | 15.00 | 16.20 |
| Cadmium | µg/L | | | 0.003 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.04 | 0.27 | 0.18 | 0.10 | 0.08 | 0.22 | 0.19 |
| Cobalt | µg/L | | | 0.010 | 0.028 | 0.013 | 0.041 | 0.014 | 0.023 | 0.019 |
| Copper | µg/L | | | 0.31 | 0.34 | 0.42 | 0.09 | 0.31 | 0.35 | 0.41 |
| Iron | µg/L | | | 20.3 | 27.2 | 7.2 | 31.7 | 25.3 | 29.9 | 14.2 |
| Lead | µg/L | | | 0.004 | 0.004 | 0.002 | 0.014 | <0.001 | 0.007 | <0.001 |
| Manganese | µg/L | | | 3.7 | 0.1 | 0.2 | 30.2 | 1.2 | 0.9 | 1.9 |
| Molybdenum | µg/L | | | 0.026 | 0.041 | 0.035 | 0.015 | 0.025 | 0.038 | 0.041 |
| Nickel | µg/L | | | 0.118 | 0.273 | 0.105 | 0.100 | 0.145 | 0.328 | 0.176 |
| Selenium | µg/L | | | 0.3 | 0.4 | 0.5 | 0.2 | 0.3 | 0.4 | 0.3 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 88.7 | 90.5 | 92.0 | 26.9 | 87.0 | 90.2 | 94.8 |
| Uranium | µg/L | | | 0.0073 | 0.0080 | 0.0071 | 0.0043 | 0.0055 | 0.0087 | 0.0093 |
| Vanadium | µg/L | | | <0.01 | 0.052 | 0.069 | 0.046 | 0.014 | 0.068 | 0.051 |
| Zinc | µg/L | | | 0.45 | 0.80 | 0.54 | 0.98 | 0.34 | <0.05 | 0.07 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.04 | 0.04 | 0.05 | 0.02 | 0.04 | 0.05 | 0.05 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Doris Lake Top | | | | Doris Lake Bottom | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-May-08 | 16-Jul-08 | 17-Aug-08 | 11-Sep-08 | 24-May-08 | 16-Jul-08 | 17-Aug-08 | 11-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 35.2 | 29.9 | 27.0 | 27.3 | 35.1 | 31.8 | 27.2 | 27.4 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 56.3 | 50.4 | 44.9 | 46.4 | 54.6 | 52.6 | 45.3 | 46.0 |
| Specific Conductivity (lab) | µS/cm | | | 321 | 300 | 265 | 267 | 322 | 317 | 265 | 267 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | **6.1** | 7.0 | 8.0 | 8.0 | **6.1** | 7.0 | 8.0 | 8.0 |
| Total Dissolved Solids | mg/L | | <500 | 176.0 | 144.0 | 128.0 | 128.0 | 174.0 | 153.0 | 132.0 | 126.0 |
| Total Suspended Solids | mg/L | | | 1 | 3 | 6 | 5 | 2 | 3 | 4 | 6 |
| True Colour | TCU | | <15 | **15** | 14 | 12 | **22** | **15** | 14 | 12 | **22** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 26 | 25 | 34 | 31 | 34 | 28 | 32 | 32 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.56 | 0.47 | 0.48 | 0.59 | 0.57 | 0.56 | 0.52 | 0.59 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.007 | 0.005 | 0.011 | 0.007 | 0.004 | 0.007 | 0.005 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.015 | 0.014 | <0.005 | <0.005 | 0.027 | 0.017 | 0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.013 | 0.014 | <0.005 | <0.005 | 0.025 | 0.017 | 0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.92 | 1.07 | 1.49 | 1.56 | 1.12 | 1.07 | 1.48 | 1.12 |
| Dissolved Organic Carbon | mg/L | | | 5.8 | 6.8 | 6.3 | 6.4 | 5.8 | 7.1 | 5.9 | 5.8 |
| Total Organic Carbon | mg/L | | | 6.72 | 7.87 | 7.79 | 7.96 | 6.92 | 8.17 | 7.38 | 6.92 |
| Chlorophyll *a* | µg/L | | | - | 7.89 | 0.56 | 15.86 | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 43 | 36 | 33 | 33 | 43 | 39 | 33 | 33 |
| Calcium (total) | mg/L | | | 8.47 | 7.82 | 7.31 | 7.51 | 8.76 | 8.38 | 7.17 | 7.57 |
| Calcium (extractable) | mg/L | | | 9.13 | 7.98 | 7.44 | 7.73 | 8.87 | 8.37 | 7.46 | 7.64 |
| Calcium (dissolved) | mg/L | | | 8.31 | 7.68 | 6.99 | 7.05 | 8.45 | 8.12 | 6.98 | 7.19 |
| Chloride | mg/L | | <250 | 83.1 | 70.3 | 61.8 | 62.5 | 82.8 | 73.9 | 63.0 | 60.9 |
| Magnesium (total) | mg/L | | | 6.84 | 6.78 | 6.41 | 6.52 | 8.39 | 7.30 | 6.33 | 6.56 |
| Magnesium (extractable) | mg/L | | | 8.13 | 7.39 | 6.40 | 6.59 | 7.88 | 7.69 | 6.48 | 6.53 |
| Magnesium (dissolved) | mg/L | | | 6.78 | 6.65 | 6.12 | 6.12 | 8.15 | 7.17 | 6.20 | 6.25 |
| Potassium (total) | mg/L | | | 2.570 | 2.520 | 2.390 | 2.320 | 2.790 | 2.700 | 2.360 | 2.360 |
| Potassium (extractable) | mg/L | | | 3.2 | 2.6 | 2.2 | 2.2 | 3.2 | 2.7 | 2.3 | 2.2 |
| Potassium (dissolved) | mg/L | | | 2.56 | 2.45 | 2.25 | 2.12 | 2.64 | 2.60 | 2.25 | 2.19 |
| Sodium (total) | mg/L | | | 32.50 | 33.80 | 32.70 | 31.60 | 39.90 | 36.80 | 32.70 | 32.10 |
| Sodium (extractable) | mg/L | | | 45.5 | 35.9 | 32.1 | 30.6 | 45.8 | 37.8 | 32.4 | 30.6 |
| Sodium (dissolved) | mg/L | | | 31.50 | 33.20 | 31.20 | 29.70 | 39.40 | 36.20 | 32.10 | 30.60 |
| Sulfate | mg/L | | <500 | 6 | <3 | <3 | <3 | 4 | 4 | 4 | <3 |
| Anions | meq/L | | | 3.17 | 2.62 | 2.33 | 2.35 | 3.13 | 2.80 | 2.41 | 2.31 |
| Cations | meq/L | | | 3.19 | 2.63 | 2.35 | 2.31 | 3.16 | 2.76 | 2.37 | 2.31 |
| Ionic Balance | N/A | | | 1.01 | 1.00 | 1.01 | 0.98 | 1.01 | 0.99 | 0.99 | 1.00 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **7.1** | 52.5 | 68.3 | 71.2 | **14.3** | 74.2 | 82.5 | 88.1 |
| Antimony | µg/L | | 6 | 0.115 | 0.015 | 0.015 | 0.014 | 0.098 | 0.014 | 0.014 | 0.017 |
| Arsenic | µg/L | 5 | 10 | 0.599 | 0.515 | 0.549 | 0.444 | 0.571 | 0.566 | 0.562 | 0.496 |
| Barium | µg/L | | 1000 | 3.06 | 3.74 | 3.54 | 3.39 | 3.38 | 4.25 | 3.61 | 3.64 |
| Beryllium | µg/L | | | <0.003 | 0.004 | 0.004 | 0.003 | <0.003 | 0.004 | <0.003 | <0.003 |
| Bismuth | µg/L | | | <0.001 | <0.001 | 0.002 | <0.001 | 0.007 | 0.003 | 0.001 | 0.013 |
| Boron | µg/L | | 5000 | 29.30 | 23.90 | 22.50 | 22.00 | 28.40 | 26.00 | 23.10 | 22.60 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.002 | 0.003 | <0.002 | <0.002 | 0.005 | <0.002 | 0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.22 | 0.25 | 0.23 | 0.27 | 0.22 | 0.30 | 0.20 | 0.31 |
| Cobalt | µg/L | | | 0.025 | 0.062 | 0.038 | 0.035 | 0.021 | 0.077 | 0.039 | 0.048 |
| Copper | µg/L | 2 - 4 | <1000 | 1.19 | 1.66 | 1.43 | 1.46 | 1.36 | 1.82 | 1.46 | 1.48 |
| Iron | µg/L | 300 | <300 | 14.6 | 216 | 90.9 | 74.8 | 14.6 | 282 | 97.6 | 95.8 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.056 | 0.033 | 0.027 | <0.001 | 0.086 | 0.025 | 0.053 |
| Manganese | µg/L | | <50 | 3.8 | **50.5** | 16.0 | 9.0 | 4.1 | **58.7** | 16.4 | 10.5 |
| Mercury | ng/L | 26 | 1000 | <0.6 | <0.6 | 1.4 | 0.9 | 0.9 | 1.1 | 1.6 | 0.7 |
| Molybdenum | µg/L | 73 | | 0.155 | 0.144 | 0.138 | 0.143 | 0.145 | 0.144 | 0.134 | 0.152 |
| Nickel | µg/L | 25 - 150 | | 0.370 | 0.452 | 0.466 | 0.476 | 0.399 | 0.572 | 0.437 | 0.532 |
| Selenium | µg/L | 1 | 10 | 0.3 | <0.1 | **1.2** | 0.7 | 0.3 | 0.2 | **1.1** | 0.9 |
| Silver | µg/L | 0.1 | | 0.0034 | 0.0681 | <0.0005 | <0.0005 | 0.0062 | 0.0017 | 0.0007 | 0.0150 |
| Strontium | µg/L | | | 48.0 | 42.7 | 38.5 | 38.8 | 49.2 | 45.3 | 37.5 | 39.0 |
| Thallium | µg/L | 0.8 | | 0.0005 | 0.0015 | 0.0037 | 0.0029 | 0.0007 | 0.0037 | 0.0031 | 0.0083 |
| Tin | µg/L | | | 0.98 | <0.03 | <0.03 | <0.03 | 1.21 | 0.03 | 0.04 | <0.03 |
| Uranium | µg/L | | 20 | 0.0388 | 0.0339 | 0.0345 | 0.0330 | 0.0325 | 0.0382 | 0.0336 | 0.0355 |
| Vanadium | µg/L | | | <0.01 | 0.129 | 0.116 | 0.153 | 0.030 | 0.196 | 0.114 | 0.163 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 0.67 | 0.32 | 0.31 | <0.1 | 0.80 | 0.91 | 0.39 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 0.7 | 5.8 | 5.6 | 5.6 | 1.2 | 5.7 | 5.6 | 5.8 |
| Antimony | µg/L | | | 0.114 | 0.015 | 0.015 | 0.014 | 0.097 | 0.013 | 0.014 | 0.016 |
| Arsenic | µg/L | | | 0.586 | 0.452 | 0.464 | 0.399 | 0.506 | 0.479 | 0.471 | 0.419 |
| Barium | µg/L | | | 2.74 | 2.87 | 2.49 | 2.37 | 2.93 | 3.17 | 2.46 | 2.39 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 26.60 | 22.80 | 20.80 | 19.90 | 26.20 | 24.90 | 21.70 | 20.50 |
| Cadmium | µg/L | | | <0.002 | 0.002 | <0.002 | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.22 | 0.25 | 0.22 | 0.25 | 0.21 | 0.30 | 0.19 | 0.25 |
| Cobalt | µg/L | | | 0.022 | 0.018 | 0.018 | 0.017 | 0.018 | 0.020 | 0.022 | 0.021 |
| Copper | µg/L | | | 1.18 | 1.48 | 1.42 | 1.45 | 1.35 | 1.80 | 1.45 | 1.32 |
| Iron | µg/L | | | 9.1 | 55.7 | 9.1 | 9.3 | 2.0 | 66.6 | 7.2 | 12.0 |
| Lead | µg/L | | | <0.001 | 0.011 | 0.008 | <0.001 | <0.001 | 0.019 | 0.007 | 0.052 |
| Manganese | µg/L | | | 2.7 | 16.1 | 0.1 | 0.1 | 2.9 | 17.5 | 0.1 | 0.1 |
| Molybdenum | µg/L | | | 0.153 | 0.140 | 0.131 | 0.131 | 0.144 | 0.144 | 0.129 | 0.152 |
| Nickel | µg/L | | | 0.195 | 0.263 | 0.206 | 0.191 | 0.146 | 0.316 | 0.184 | 0.211 |
| Selenium | µg/L | | | 0.3 | <0.1 | 0.8 | 0.6 | 0.3 | 0.2 | 0.9 | 0.8 |
| Silver | µg/L | | | 0.0014 | <0.0005 | <0.0005 | <0.0005 | 0.0045 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 47.2 | 41.7 | 37.3 | 36.4 | 47.7 | 43.8 | 36.1 | 36.7 |
| Uranium | µg/L | | | 0.0294 | 0.0268 | 0.0282 | 0.0266 | 0.0270 | 0.0275 | 0.0278 | 0.0298 |
| Vanadium | µg/L | | | <0.01 | 0.080 | 0.040 | 0.075 | 0.029 | 0.080 | 0.056 | 0.100 |
| Zinc | µg/L | | | <0.05 | 0.67 | 0.32 | 0.08 | <0.05 | 0.79 | 0.90 | <0.05 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | | | | |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.07 | 0.06 | 0.07 | 0.07 | 0.07 | 0.06 | 0.06 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Doris Outflow | | | | Little Roberts Lake | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 22-Jun-08 | 17-Jul-08 | 14-Aug-08 | 12-Sep-08 | 25-May-08 | 14-Jul-08 | 18-Aug-08 | 12-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 25.8 | 30.9 | 27.5 | 27.6 | 63.6 | 23.0 | 24.7 | 24.5 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 41.8 | 49.8 | 45.1 | 46.2 | 108.0 | 39.8 | 44.0 | 44.6 |
| Specific Conductivity (lab) | µS/cm | | | 271 | 306 | 266 | 266 | 679 | 253 | 260 | 270 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.0 | 7.6 | 8.0 | 7.5 | **6.4** | 7.3 | 7.7 | 7.8 |
| Total Dissolved Solids | mg/L | | <500 | 137.0 | 147.0 | 128.0 | 126.0 | 364.0 | 124.0 | 127.0 | 129.0 |
| Total Suspended Solids | mg/L | | | 11 | 2 | 5 | 7 | 1 | 3 | 2 | 3 |
| True Colour | TCU | | <15 | **44** | 13 | 10 | **20** | **25** | 13 | 11 | **20** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 30 | 26 | 25 | 40 | 27 | 24 | 20 | 24 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.55 | 0.57 | 0.51 | 0.56 | 0.66 | 0.33 | 0.36 | 0.46 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.009 | 0.008 | 0.005 | 0.006 | 0.037 | 0.011 | 0.005 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | 0.040 | 0.013 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | 0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | 0.038 | 0.012 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 1.30 | 1.13 | 1.37 | 1.95 | 0.51 | 0.39 | 0.93 | 1.21 |
| Dissolved Organic Carbon | mg/L | | | 8.3 | 5.7 | 5.8 | 5.7 | 8.6 | 5.3 | 5.1 | 5.5 |
| Total Organic Carbon | mg/L | | | 9.60 | 6.83 | 7.17 | 7.65 | 9.11 | 5.69 | 6.03 | 6.71 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | 3.21 | 4.29 | 10.40 |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 31 | 38 | 34 | 34 | 77 | 28 | 30 | 30 |
| Calcium (total) | mg/L | | | 6.96 | 7.92 | 7.52 | 7.87 | 16.00 | 5.84 | 6.50 | 6.85 |
| Calcium (extractable) | mg/L | | | 6.75 | 8.27 | 7.52 | 7.81 | 16.30 | 6.00 | 6.82 | 6.83 |
| Calcium (dissolved) | mg/L | | | 6.70 | 7.81 | 7.18 | 7.49 | 16.00 | 5.63 | 6.07 | 6.53 |
| Chloride | mg/L | | <250 | 66.8 | 72.8 | 62.1 | 61.4 | 180.0 | 60.1 | 62.2 | 62.7 |
| Magnesium (total) | mg/L | | | 6.30 | 6.79 | 6.26 | 6.59 | 15.90 | 6.10 | 6.46 | 6.82 |
| Magnesium (extractable) | mg/L | | | 6.06 | 7.09 | 6.39 | 6.48 | 16.30 | 6.04 | 6.56 | 6.70 |
| Magnesium (dissolved) | mg/L | | | 6.07 | 6.70 | 5.98 | 6.30 | 15.74 | 5.96 | 6.10 | 6.52 |
| Potassium (total) | mg/L | | | 2.730 | 2.490 | 2.290 | 2.320 | 5.390 | 2.150 | 2.110 | 2.190 |
| Potassium (extractable) | mg/L | | | 2.5 | 2.6 | 2.2 | 2.1 | 5.9 | 2.1 | | |
| Potassium (dissolved) | mg/L | | | 2.51 | 2.45 | 2.16 | 2.17 | 5.36 | 2.04 | 1.97 | 2.06 |
| Sodium (total) | mg/L | | | 31.10 | 33.90 | 30.50 | 31.60 | 85.80 | 30.40 | 31.70 | 33.30 |
| Sodium (extractable) | mg/L | | | 33.9 | 36.0 | 31.4 | 29.8 | 97.3 | 31.1 | 32.5 | 31.6 |
| Sodium (dissolved) | mg/L | | | 30.30 | 33.70 | 29.20 | 30.20 | 85.40 | 29.50 | 30.20 | 32.00 |
| Sulfate | mg/L | | <500 | 6 | <3 | <3 | <3 | 10 | 4 | <3 | 4 |
| Anions | meq/L | | | 2.52 | 2.71 | 2.35 | 2.33 | 6.56 | 2.25 | 2.29 | 2.35 |
| Cations | meq/L | | | 2.37 | 2.63 | 2.32 | 2.27 | 6.54 | 2.21 | 2.35 | 2.32 |
| Ionic Balance | N/A | | | 0.94 | 0.97 | 0.99 | 0.98 | 1.00 | 0.98 | 1.02 | 0.99 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **414** | 60.0 | 45.0 | 74.5 | **12.0** | **122** | 95.7 | 85.0 |
| Antimony | µg/L | | 6 | 0.016 | 0.017 | 0.014 | 0.014 | 0.097 | 0.011 | 0.027 | 0.015 |
| Arsenic | µg/L | 5 | 10 | 0.500 | 0.526 | 0.519 | 0.486 | 1.230 | 0.481 | 0.558 | 0.500 |
| Barium | µg/L | | 1000 | 8.21 | 3.83 | 3.24 | 3.44 | 9.14 | 3.78 | 3.83 | 3.46 |
| Beryllium | µg/L | | | 0.016 | <0.003 | <0.003 | <0.003 | <0.003 | 0.005 | <0.003 | 0.005 |
| Bismuth | µg/L | | | 0.002 | 0.003 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | 0.001 |
| Boron | µg/L | | 5000 | 21.50 | 23.40 | 20.20 | 21.60 | 58.00 | 23.20 | 23.70 | 23.50 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.007 | 0.003 | <0.002 | <0.002 | <0.002 | 0.003 | 0.008 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.85 | 0.22 | 0.27 | 0.29 | 0.50 | 0.38 | 0.48 | 0.29 |
| Cobalt | µg/L | | | 0.320 | 0.067 | 0.044 | 0.055 | 0.089 | 0.070 | 0.055 | 0.041 |
| Copper | µg/L | 2 - 4 | <1000 | **2.06** | 1.55 | 1.38 | 1.57 | 1.85 | 1.53 | 1.46 | 1.61 |
| Iron | µg/L | 300 | <300 | **664** | 218 | 97.2 | 130 | **484** | 184 | 143 | 110 |
| Lead | µg/L | 1 - 7 | 10 | 0.219 | 0.028 | 0.017 | 0.047 | 0.231 | 0.052 | 0.113 | 0.044 |
| Manganese | µg/L | | <50 | **61.9** | 44.3 | 14.8 | 14.1 | **65.5** | 14.9 | 6.7 | 5.4 |
| Mercury | ng/L | 26 | 1000 | 1.7 | <0.6 | <0.6 | 1.0 | 0.7 | 2.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.164 | 0.138 | 0.140 | 0.146 | 0.265 | 0.162 | 0.190 | 0.181 |
| Nickel | µg/L | 25 - 150 | | 1.360 | 0.530 | 0.508 | 0.485 | 0.775 | 0.590 | 0.396 | 0.571 |
| Selenium | µg/L | 1 | 10 | 0.7 | 0.4 | **1.1** | 0.8 | 0.8 | 0.8 | **1.1** | **1.1** |
| Silver | µg/L | 0.1 | | <0.0005 | 0.0041 | 0.0008 | <0.0005 | 0.0142 | 0.0017 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 37.7 | 42.6 | 40.1 | 39.8 | 106.0 | 35.9 | 41.0 | 40.5 |
| Thallium | µg/L | 0.8 | | 0.0021 | 0.0034 | 0.0029 | 0.0037 | 0.0006 | 0.0023 | 0.0003 | 0.0030 |
| Tin | µg/L | | | 0.15 | <0.03 | <0.03 | <0.03 | 0.15 | <0.03 | 0.49 | <0.03 |
| Uranium | µg/L | | 20 | 0.0564 | 0.0318 | 0.0329 | 0.0356 | 0.0543 | 0.0481 | 0.0397 | 0.0406 |
| Vanadium | µg/L | | | 0.769 | 0.112 | 0.072 | 0.159 | <0.01 | 0.248 | 0.181 | 0.123 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 3.51 | 0.66 | 0.57 | <0.1 | 0.73 | 1.16 | 1.50 | <0.1 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 51.2 | 5.1 | 5.7 | 5.1 | 3.4 | 16.9 | 16.3 | 27.6 |
| Antimony | µg/L | | | 0.016 | 0.017 | 0.014 | 0.013 | 0.096 | 0.011 | 0.026 | 0.015 |
| Arsenic | µg/L | | | 0.462 | 0.442 | 0.420 | 0.391 | 1.230 | 0.424 | 0.483 | 0.435 |
| Barium | µg/L | | | 3.62 | 2.98 | 2.53 | 2.43 | 8.80 | 2.55 | 2.76 | 2.69 |
| Beryllium | µg/L | | | 0.008 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 20.00 | 22.40 | 18.80 | 20.30 | 56.20 | 22.10 | 21.80 | 22.40 |
| Cadmium | µg/L | | | 0.003 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | 0.003 | <0.002 |
| Chromium | µg/L | | | 0.44 | 0.18 | 0.27 | 0.21 | 0.50 | 0.37 | 0.40 | 0.26 |
| Cobalt | µg/L | | | 0.093 | 0.019 | 0.024 | 0.017 | 0.071 | 0.018 | 0.021 | 0.018 |
| Copper | µg/L | | | 2.04 | 1.38 | 1.37 | 1.20 | 1.83 | 1.42 | 1.45 | 1.32 |
| Iron | µg/L | | | 270.0 | 60.6 | 20.1 | 13.2 | 316.0 | 50.8 | 46.2 | 31.1 |
| Lead | µg/L | | | 0.072 | 0.008 | 0.016 | <0.001 | 0.123 | 0.013 | 0.038 | 0.022 |
| Manganese | µg/L | | | 22.9 | 19.8 | 0.2 | 0.1 | 60.1 | 3.3 | 0.5 | 0.4 |
| Molybdenum | µg/L | | | 0.149 | 0.135 | 0.134 | 0.133 | 0.251 | 0.160 | 0.164 | 0.167 |
| Nickel | µg/L | | | 0.851 | 0.323 | 0.339 | 0.185 | 0.716 | 0.403 | 0.225 | 0.362 |
| Selenium | µg/L | | | 0.7 | 0.2 | 0.7 | 0.7 | 0.8 | 0.7 | 1.0 | 0.8 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0020 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 36.3 | 42.1 | 39.7 | 37.6 | 105.0 | 34.4 | 38.6 | 38.5 |
| Uranium | µg/L | | | 0.0387 | 0.0256 | 0.0263 | 0.0274 | 0.0460 | 0.0312 | 0.0320 | 0.0353 |
| Vanadium | µg/L | | | 0.228 | 0.052 | 0.071 | 0.068 | <0.01 | 0.115 | 0.097 | 0.055 |
| Zinc | µg/L | | | 2.94 | 0.38 | 0.56 | <0.05 | 0.72 | 1.00 | 1.49 | <0.05 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | | | | |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.06 | 0.07 | 0.06 | 0.06 | <0.01 | 0.05 | 0.05 | 0.05 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Little Roberts Outflow | | | | Roberts Lake Top | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 19-Jun-08 | 17-Jul-08 | 14-Aug-08 | 12-Sep-08 | 25-May-08 | 15-Jul-08 | 18-Aug-08 | 12-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 25.2 | 27.4 | 24.9 | 24.7 | 25.4 | 18.5 | 21.5 | 21.9 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 41.5 | 43.3 | 44.4 | 43.0 | 45.7 | 32.0 | 38.8 | 40.1 |
| Specific Conductivity (lab) | µS/cm | | | 265 | 282 | 268 | 270 | 277 | 211 | 244 | 264 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.8 | 7.7 | 7.8 | 7.8 | 6.6 | 7.5 | 7.9 | 7.8 |
| Total Dissolved Solids | mg/L | | <500 | 134.0 | 136.0 | 128.0 | 126.0 | 148.0 | 104.0 | 117.0 | 123.0 |
| Total Suspended Solids | mg/L | | | 8 | 3 | 3 | 2 | <1 | 4 | <1 | 2 |
| True Colour | TCU | | <15 | **38** | **16** | 12 | **20** | 7 | 13 | 11 | **20** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 29 | 19 | 20 | 25 | 9 | 17 | 16 | 22 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.47 | 0.45 | 0.38 | 0.44 | 0.29 | 0.27 | 0.30 | 0.40 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.007 | 0.030 | 0.006 | 0.013 | 0.004 | 0.003 | 0.004 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | 0.049 | 0.016 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | 0.047 | 0.016 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.66 | 0.70 | 0.64 | 1.12 | 0.07 | 0.33 | 0.44 | 0.83 |
| Dissolved Organic Carbon | mg/L | | | 7.9 | 5.7 | 5.7 | 5.8 | 4.2 | 5.3 | 4.4 | 5.0 |
| Total Organic Carbon | mg/L | | | 8.56 | 6.40 | 6.34 | 6.92 | 4.27 | 5.63 | 4.84 | 5.83 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | 2.56 | 3.26 | 6.03 |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 31 | 33 | 30 | 30 | 31 | 23 | 26 | 27 |
| Calcium (total) | mg/L | | | 6.72 | 6.95 | 6.69 | 7.02 | 6.36 | 4.48 | 5.24 | 5.77 |
| Calcium (extractable) | mg/L | | | 6.59 | 6.93 | 6.97 | 6.71 | 6.70 | 4.49 | 5.53 | 5.62 |
| Calcium (dissolved) | mg/L | | | 6.53 | 6.68 | 6.61 | 6.57 | 6.05 | 4.28 | 5.08 | 5.48 |
| Chloride | mg/L | | <250 | 65.6 | 65.9 | 63.0 | 61.4 | 70.6 | 49.4 | 58.0 | 61.9 |
| Magnesium (total) | mg/L | | | 6.18 | 6.40 | 6.56 | 6.91 | 7.03 | 4.98 | 5.83 | 6.65 |
| Magnesium (extractable) | mg/L | | | 6.08 | 6.31 | 6.55 | 6.38 | 7.43 | 5.06 | 6.07 | 6.33 |
| Magnesium (dissolved) | mg/L | | | 5.99 | 6.20 | 6.50 | 6.52 | 7.05 | 4.81 | 5.71 | 6.33 |
| Potassium (total) | mg/L | | | 2.630 | 2.270 | 2.130 | 2.220 | 2.340 | 1.820 | 1.950 | 2.100 |
| Potassium (extractable) | mg/L | | | 2.4 | 2.4 | | | 2.7 | 1.8 | | 1.9 |
| Potassium (dissolved) | mg/L | | | 2.37 | 2.15 | 2.07 | 2.06 | 2.26 | 1.72 | 1.87 | 1.94 |
| Sodium (total) | mg/L | | | 30.20 | 31.90 | 32.20 | 33.60 | 36.10 | 25.20 | 30.00 | 33.50 |
| Sodium (extractable) | mg/L | | | 33.4 | 33.6 | 32.6 | 31.0 | 39.7 | 25.2 | 31.2 | 31.8 |
| Sodium (dissolved) | mg/L | | | 29.90 | 30.90 | 31.90 | 31.70 | 34.10 | 24.40 | 29.00 | 32.00 |
| Sulfate | mg/L | | <500 | 5 | 4 | <3 | 4 | 6 | 7 | 4 | <3 |
| Anions | meq/L | | | 2.46 | 2.50 | 2.32 | 2.30 | 2.64 | 1.92 | 2.14 | 2.23 |
| Cations | meq/L | | | 2.34 | 2.39 | 2.36 | 2.26 | 2.71 | 1.78 | 2.13 | 2.23 |
| Ionic Balance | N/A | | | 0.95 | 0.95 | 1.02 | 0.98 | 1.03 | 0.93 | 0.99 | 1.00 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **563** | **119** | 86.1 | 95.5 | 19.5 | **162** | 72.8 | **108** |
| Antimony | µg/L | | 6 | 0.016 | 0.015 | 0.013 | 0.014 | 0.136 | 0.013 | 0.014 | 0.018 |
| Arsenic | µg/L | 5 | 10 | 0.517 | 0.506 | 0.557 | 0.509 | 0.523 | 0.422 | 0.489 | 0.508 |
| Barium | µg/L | | 1000 | 9.79 | 4.01 | 3.84 | 3.65 | 3.04 | 3.94 | 3.01 | 3.57 |
| Beryllium | µg/L | | | 0.016 | 0.007 | 0.008 | <0.003 | <0.003 | <0.003 | <0.003 | 0.007 |
| Bismuth | µg/L | | | <0.001 | 0.001 | 0.005 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 |
| Boron | µg/L | | 5000 | 22.50 | 23.90 | 22.90 | 23.60 | 28.80 | 19.70 | 23.20 | 24.50 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.004 | 0.003 | 0.002 | <0.002 | <0.002 | 0.005 | <0.002 | 0.004 |
| Chromium | µg/L | 1 or 16 | 50 | 0.93 | 0.31 | 0.30 | 0.28 | 0.23 | 0.43 | 0.37 | 0.30 |
| Cobalt | µg/L | | | 0.274 | 0.077 | 0.051 | 0.046 | 0.025 | 0.070 | 0.030 | 0.040 |
| Copper | µg/L | 2 - 4 | <1000 | 1.88 | 1.58 | 1.50 | 1.59 | 1.36 | 1.73 | **7.26** | 1.58 |
| Iron | µg/L | 300 | <300 | **672** | 218 | 135 | 116 | 23.0 | 212 | 76.1 | 109 |
| Lead | µg/L | 1 - 7 | 10 | 0.196 | 0.047 | 0.023 | 0.036 | 0.012 | 0.098 | 0.239 | 0.078 |
| Manganese | µg/L | | <50 | 43.7 | 21.5 | 8.1 | 5.5 | 1.3 | 13.3 | 3.6 | 3.7 |
| Mercury | ng/L | 26 | 1000 | 1.1 | 0.8 | 1.0 | <0.6 | <0.6 | 1.9 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.177 | 0.163 | 0.178 | 0.169 | 0.202 | 0.166 | 0.174 | 0.191 |
| Nickel | µg/L | 25 - 150 | | 1.140 | 0.541 | 0.559 | 0.546 | 0.446 | 0.558 | 0.280 | 0.528 |
| Selenium | µg/L | 1 | 10 | 0.7 | 0.5 | **1.1** | **1.1** | 0.1 | 0.6 | 1.0 | 0.9 |
| Silver | µg/L | 0.1 | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0026 | 0.0022 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 39.2 | 41.3 | 41.1 | 41.2 | 44.2 | 31.1 | 36.4 | 38.7 |
| Thallium | µg/L | 0.8 | | 0.0032 | 0.0028 | 0.0047 | 0.0038 | 0.0008 | 0.0039 | <0.0003 | 0.0032 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | 1.21 | <0.03 | 0.04 | 0.04 |
| Uranium | µg/L | | 20 | 0.0600 | 0.0397 | 0.0438 | 0.0436 | 0.0496 | 0.0502 | 0.0420 | 0.0486 |
| Vanadium | µg/L | | | 0.982 | 0.244 | 0.089 | 0.096 | 0.045 | 0.311 | 0.105 | 0.152 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 2.18 | 0.99 | 0.14 | <0.1 | <0.1 | 1.00 | 4.08 | 0.15 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 62.1 | 13.0 | 20.9 | 26.9 | 3.0 | 24.4 | 11.8 | 29.3 |
| Antimony | µg/L | | | 0.016 | 0.015 | 0.013 | 0.014 | 0.135 | 0.013 | 0.014 | 0.018 |
| Arsenic | µg/L | | | 0.441 | 0.431 | 0.521 | 0.464 | 0.484 | 0.349 | 0.421 | 0.438 |
| Barium | µg/L | | | 3.47 | 2.63 | 2.78 | 2.63 | 2.53 | 2.22 | 2.24 | 2.59 |
| Beryllium | µg/L | | | 0.005 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 21.10 | 22.90 | 22.50 | 22.30 | 27.40 | 18.90 | 21.70 | 24.00 |
| Cadmium | µg/L | | | 0.004 | <0.002 | <0.002 | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.43 | 0.16 | 0.29 | 0.26 | 0.22 | 0.32 | 0.37 | 0.23 |
| Cobalt | µg/L | | | 0.070 | 0.015 | 0.026 | 0.019 | 0.020 | 0.012 | 0.016 | 0.017 |
| Copper | µg/L | | | 1.86 | 1.35 | 1.49 | 1.41 | 1.35 | 1.44 | 3.40 | 1.38 |
| Iron | µg/L | | | 214.0 | 65.8 | 50.2 | 30.1 | 6.4 | 49.3 | 20.4 | 28.1 |
| Lead | µg/L | | | 0.067 | 0.010 | 0.012 | 0.008 | <0.001 | 0.022 | 0.048 | 0.012 |
| Manganese | µg/L | | | 15.2 | 4.7 | 0.4 | 0.3 | 0.9 | 0.9 | 0.3 | 0.2 |
| Molybdenum | µg/L | | | 0.158 | 0.147 | 0.176 | 0.161 | 0.190 | 0.148 | 0.167 | 0.188 |
| Nickel | µg/L | | | 0.699 | 0.352 | 0.494 | 0.392 | 0.389 | 0.404 | 0.213 | 0.413 |
| Selenium | µg/L | | | 0.5 | 0.2 | 1.0 | 0.9 | 0.1 | 0.6 | 0.8 | 0.8 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 36.3 | 39.1 | 40.7 | 38.6 | 42.1 | 29.5 | 35.3 | 36.4 |
| Uranium | µg/L | | | 0.0434 | 0.0323 | 0.0381 | 0.0344 | 0.0449 | 0.0388 | 0.0328 | 0.0390 |
| Vanadium | µg/L | | | 0.238 | 0.064 | 0.080 | 0.064 | 0.044 | 0.133 | 0.092 | 0.069 |
| Zinc | µg/L | | | 1.94 | 0.31 | 0.14 | <0.05 | <0.05 | 0.65 | 2.65 | <0.05 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | | | | |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.04 | 0.06 | 0.05 | 0.06 | 0.06 | 0.04 | 0.05 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Roberts Lake Bottom | | | | Roberts Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 25-May-08 | 15-Jul-08 | 18-Aug-08 | 12-Sep-08 | 19-Jun-08 | 17-Jul-08 | 14-Aug-08 | 12-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 28.4 | 18.9 | 22.0 | 22.0 | 18.3 | 20.1 | 21.8 | 21.8 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 50.1 | 32.6 | 38.7 | 40.4 | 30.9 | 32.9 | 40.0 | 40.7 |
| Specific Conductivity (lab) | µS/cm | | | 305 | 213 | 244 | 265 | 203 | 226 | 245 | 268 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.6 | 7.5 | 7.9 | 7.8 | 6.8 | **8.6** | 7.5 | 8.1 |
| Total Dissolved Solids | mg/L | | <500 | 165.0 | 102.0 | 119.0 | 124.0 | 97.5 | 109.0 | 117.0 | 123.0 |
| Total Suspended Solids | mg/L | | | <1 | 5 | <1 | 2 | 6 | 2 | 2 | 3 |
| True Colour | TCU | | <15 | 12 | 13 | 11 | **24** | **35** | **16** | <1 | **20** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 11 | 17 | 15 | 22 | 30 | 14 | 15 | 24 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.30 | 0.29 | 0.28 | 0.46 | 0.40 | 0.33 | 0.30 | 0.41 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.005 | 0.005 | 0.009 | 0.006 | 0.005 | 0.012 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.008 | 0.015 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.006 | 0.015 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.16 | 0.40 | 0.43 | 0.88 | 0.49 | 0.37 | 0.46 | 0.76 |
| Dissolved Organic Carbon | mg/L | | | 4.5 | 5.0 | 4.4 | 5.4 | 7.3 | 4.2 | 4.8 | 5.5 |
| Total Organic Carbon | mg/L | | | 4.66 | 5.40 | 4.83 | 6.28 | 7.79 | 4.57 | 5.26 | 6.26 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 35 | 23 | 27 | 27 | 22 | 25 | 27 | 27 |
| Calcium (total) | mg/L | | | 6.82 | 4.56 | 5.26 | 5.76 | 4.48 | 4.77 | 5.45 | 5.76 |
| Calcium (extractable) | mg/L | | | 7.27 | 4.52 | 5.50 | 5.63 | 4.40 | 4.75 | 5.70 | 5.66 |
| Calcium (dissolved) | mg/L | | | 6.54 | 4.29 | 5.09 | 5.35 | 4.26 | 4.54 | 5.35 | 5.53 |
| Chloride | mg/L | | <250 | 78.7 | 49.7 | 57.5 | 62.5 | 48.2 | 53.3 | 57.5 | 62.3 |
| Magnesium (total) | mg/L | | | 7.88 | 5.09 | 6.04 | 6.71 | 4.81 | 5.23 | 6.10 | 6.73 |
| Magnesium (extractable) | mg/L | | | 7.75 | 5.18 | 6.06 | 6.39 | 4.84 | 5.10 | 6.27 | 6.45 |
| Magnesium (dissolved) | mg/L | | | 7.54 | 4.84 | 5.98 | 6.25 | 4.57 | 4.98 | 5.95 | 6.43 |
| Potassium (total) | mg/L | | | 2.520 | 1.840 | 1.960 | 2.180 | 2.120 | 1.820 | 2.010 | 2.100 |
| Potassium (extractable) | mg/L | | | 3.0 | 1.8 | | | 1.8 | 1.8 | 1.9 | 1.9 |
| Potassium (dissolved) | mg/L | | | 2.42 | 1.72 | 1.89 | 2.00 | 1.83 | 1.71 | 1.95 | 1.97 |
| Sodium (total) | mg/L | | | 39.20 | 25.50 | 30.00 | 34.80 | 23.00 | 26.30 | 30.60 | 33.90 |
| Sodium (extractable) | mg/L | | | 44.5 | 25.2 | 31.5 | 31.8 | 25.3 | 26.9 | 30.7 | 31.8 |
| Sodium (dissolved) | mg/L | | | 38.10 | 24.70 | 29.70 | 32.60 | 22.70 | 25.20 | 29.80 | 32.80 |
| Sulfate | mg/L | | <500 | 7 | 5 | <3 | <3 | <3 | 5 | <3 | <3 |
| Anions | meq/L | | | 2.93 | 1.88 | 2.13 | 2.25 | 1.77 | 2.01 | 2.10 | 2.24 |
| Cations | meq/L | | | 3.01 | 1.79 | 2.19 | 2.24 | 1.76 | 1.87 | 2.18 | 2.24 |
| Ionic Balance | N/A | | | 1.03 | 0.95 | 1.03 | 1.00 | 1.00 | 0.93 | 1.04 | 1.00 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 31.7 | **170** | 62.2 | **135** | **668** | **133** | 72.7 | **117** |
| Antimony | µg/L | | 6 | 0.037 | 0.013 | 0.010 | 0.030 | 0.015 | 0.013 | 0.014 | 0.014 |
| Arsenic | µg/L | 5 | 10 | 0.569 | 0.440 | 0.511 | 0.554 | 0.455 | 0.443 | 0.475 | 0.537 |
| Barium | µg/L | | 1000 | 3.31 | 3.97 | 3.01 | 4.29 | 10.40 | 3.68 | 3.15 | 3.69 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | 0.007 | 0.022 | 0.005 | <0.003 | 0.005 |
| Bismuth | µg/L | | | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 | 0.002 | 0.014 | <0.001 |
| Boron | µg/L | | 5000 | 30.90 | 20.00 | 23.70 | 23.90 | 19.00 | 21.70 | 23.90 | 24.70 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.002 | <0.002 | **0.030** | 0.004 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.26 | 0.42 | 0.40 | 0.50 | **1.07** | 0.30 | 0.32 | 0.30 |
| Cobalt | µg/L | | | 0.025 | 0.072 | 0.027 | 0.062 | 0.275 | 0.055 | 0.039 | 0.046 |
| Copper | µg/L | 2 - 4 | <1000 | 1.22 | 1.56 | 1.35 | **2.11** | 1.83 | 1.52 | 1.43 | 1.63 |
| Iron | µg/L | 300 | <300 | 41.8 | 220 | 76.4 | 149 | **663** | 152 | 92.4 | 119 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.069 | 0.016 | 0.177 | 0.215 | 0.049 | 0.029 | 0.083 |
| Manganese | µg/L | | <50 | 15.3 | 13.8 | 3.7 | 5.6 | 37.5 | 10.3 | 5.6 | 4.1 |
| Mercury | ng/L | 26 | 1000 | 1.0 | 1.6 | <0.6 | <0.6 | 2.0 | <0.6 | <0.6 | 0.7 |
| Molybdenum | µg/L | 73 | | 0.200 | 0.168 | 0.186 | 0.215 | 0.159 | 0.163 | 0.171 | 0.191 |
| Nickel | µg/L | 25 - 150 | | 0.438 | 0.565 | 0.312 | 0.691 | 1.080 | 0.502 | 0.519 | 0.552 |
| Selenium | µg/L | 1 | 10 | 0.3 | 0.7 | 1.0 | 0.7 | 0.4 | <0.1 | 0.9 | 1.0 |
| Silver | µg/L | 0.1 | | 0.0036 | 0.0021 | <0.0005 | <0.0005 | <0.0005 | 0.0006 | 0.0011 | <0.0005 |
| Strontium | µg/L | | | 47.2 | 31.0 | 36.6 | 39.4 | 30.0 | 33.0 | 36.1 | 39.0 |
| Thallium | µg/L | 0.8 | | 0.0007 | 0.0040 | <0.0003 | 0.0021 | 0.0048 | 0.0021 | 0.0073 | 0.0046 |
| Tin | µg/L | | | 0.08 | <0.03 | <0.03 | 0.11 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0514 | 0.0527 | 0.0442 | 0.0552 | 0.0683 | 0.0463 | 0.0498 | 0.0494 |
| Vanadium | µg/L | | | 0.033 | 0.322 | 0.155 | 0.278 | 1.150 | 0.247 | 0.120 | 0.146 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 0.73 | 0.18 | 9.42 | 2.22 | 0.57 | 0.48 | <0.1 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 4.0 | 24.0 | 12.0 | 31.2 | 72.6 | 16.7 | 12.4 | 31.7 |
| Antimony | µg/L | | | 0.036 | 0.013 | 0.010 | 0.029 | 0.015 | 0.013 | 0.014 | 0.014 |
| Arsenic | µg/L | | | 0.513 | 0.341 | 0.470 | 0.400 | 0.361 | 0.357 | 0.399 | 0.449 |
| Barium | µg/L | | | 2.73 | 2.21 | 2.35 | 2.85 | 2.94 | 2.15 | 2.29 | 2.59 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | 0.006 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 28.40 | 19.10 | 22.40 | 22.00 | 18.10 | 19.80 | 22.20 | 23.60 |
| Cadmium | µg/L | | | <0.002 | <0.002 | <0.002 | 0.013 | 0.003 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.26 | 0.30 | 0.40 | 0.40 | 0.35 | 0.14 | 0.32 | 0.23 |
| Cobalt | µg/L | | | 0.025 | 0.012 | 0.015 | 0.017 | 0.051 | 0.010 | 0.018 | 0.016 |
| Copper | µg/L | | | 1.21 | 1.42 | 1.34 | 1.48 | 1.81 | 1.31 | 1.42 | 1.38 |
| Iron | µg/L | | | 16.0 | 48.3 | 19.6 | 30.9 | 156.0 | 33.4 | 23.7 | 28.9 |
| Lead | µg/L | | | <0.001 | 0.013 | 0.005 | 0.028 | 0.048 | 0.009 | 0.007 | 0.006 |
| Manganese | µg/L | | | 12.6 | 0.9 | 0.2 | 0.4 | 9.0 | 0.4 | 0.3 | 0.2 |
| Molybdenum | µg/L | | | 0.198 | 0.149 | 0.175 | 0.172 | 0.139 | 0.162 | 0.169 | 0.173 |
| Nickel | µg/L | | | 0.414 | 0.405 | 0.287 | 0.438 | 0.617 | 0.366 | 0.458 | 0.415 |
| Selenium | µg/L | | | 0.4 | 0.6 | 0.8 | 0.5 | 0.4 | <0.1 | 0.7 | 0.9 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 45.9 | 29.2 | 35.5 | 36.5 | 28.2 | 31.3 | 35.7 | 37.5 |
| Uranium | µg/L | | | 0.0424 | 0.0384 | 0.0359 | 0.0410 | 0.0476 | 0.0379 | 0.0410 | 0.0399 |
| Vanadium | µg/L | | | 0.032 | 0.074 | 0.053 | 0.128 | 0.230 | 0.050 | 0.075 | 0.075 |
| Zinc | µg/L | | | <0.05 | 0.42 | 0.18 | 3.41 | 2.04 | 0.32 | 0.48 | <0.05 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | | | | |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | 0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.06 | 0.04 | 0.05 | 0.05 | 0.02 | 0.05 | 0.05 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Tail Lake Top | | | | Tail Lake Bottom | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-May-08 | 14-Jul-08 | 18-Aug-08 | 11-Sep-08 | 14-Jul-08 | 18-Aug-08 | 11-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 52.0 | 24.5 | 25.1 | 24.9 | 23.5 | 25.1 | 25.1 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 62.9 | 30.6 | 32.4 | 32.5 | 30.5 | 31.7 | 32.8 |
| Specific Conductivity (lab) | µS/cm | | | 275 | 137 | 142 | 143 | 137 | 142 | 143 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.2 | 7.5 | 7.9 | 7.8 | 7.5 | 7.9 | 7.8 |
| Total Dissolved Solids | mg/L | | <500 | 152.0 | 68.5 | 70.9 | 68.7 | 68.0 | 70.3 | 68.2 |
| Total Suspended Solids | mg/L | | | <1 | 2 | <1 | 3 | 1 | <1 | 2 |
| True Colour | TCU | | <15 | **15** | 11 | 10 | **22** | 11 | 10 | **22** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 15 | 11 | 13 | 15 | 17 | 11 | 12 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.47 | 0.28 | 0.28 | 0.36 | 0.27 | 0.28 | 0.34 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.008 | 0.008 | 0.006 | 0.006 | 0.007 | 0.005 | 0.008 |
| Nitrite+Nitrate - N | mg/L | | | 0.005 | 0.015 | <0.005 | <0.005 | 0.013 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.004 | 0.015 | <0.005 | <0.005 | 0.013 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.09 | 0.13 | 0.38 | 0.19 | 0.10 | 0.19 | 0.14 |
| Dissolved Organic Carbon | mg/L | | | 8.6 | 5.5 | 5.2 | 6.1 | 5.9 | 5.6 | 6.3 |
| Total Organic Carbon | mg/L | | | 8.69 | 5.63 | 5.58 | 6.29 | 6.00 | 5.79 | 6.44 |
| Chlorophyll *a* | µg/L | | | - | 0.89 | 0.73 | 1.33 | - | - | - |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 63 | 30 | 31 | 30 | 29 | 31 | 31 |
| Calcium (total) | mg/L | | | 10.90 | 5.19 | 5.01 | 5.26 | 5.06 | 5.06 | 5.37 |
| Calcium (extractable) | mg/L | | | 10.60 | 5.10 | 5.35 | 5.50 | 5.06 | 5.23 | 5.51 |
| Calcium (dissolved) | mg/L | | | 10.30 | 5.02 | 4.90 | 5.23 | 5.00 | 4.94 | 5.07 |
| Chloride | mg/L | | <250 | 59.7 | 25.6 | 27.5 | 26.6 | 25.5 | 27.3 | 26.2 |
| Magnesium (total) | mg/L | | | 9.11 | 4.39 | 4.59 | 4.47 | 4.29 | 4.71 | 4.58 |
| Magnesium (extractable) | mg/L | | | 8.86 | 4.35 | 4.62 | 4.57 | 4.35 | 4.52 | 4.62 |
| Magnesium (dissolved) | mg/L | | | 8.77 | 4.32 | 4.46 | 4.44 | 4.24 | 4.56 | 4.35 |
| Potassium (total) | mg/L | | | 2.620 | 1.400 | 1.340 | 1.330 | 1.370 | 1.360 | 1.350 |
| Potassium (extractable) | mg/L | | | 3.0 | 1.3 | | 1.3 | 1.3 | | 1.3 |
| Potassium (dissolved) | mg/L | | | 2.53 | 1.37 | 1.30 | 1.31 | 1.35 | 1.33 | 1.27 |
| Sodium (total) | mg/L | | | 29.70 | 14.00 | 13.80 | 13.70 | 13.70 | 14.10 | 14.00 |
| Sodium (extractable) | mg/L | | | 33.3 | 13.1 | 15.0 | 13.8 | 13.3 | 14.8 | 13.5 |
| Sodium (dissolved) | mg/L | | | 28.00 | 13.80 | 13.50 | 13.50 | 13.70 | 13.70 | 13.40 |
| Sulfate | mg/L | | <500 | 5 | 4 | <3 | <3 | 4 | <3 | <3 |
| Anions | meq/L | | | 2.83 | 1.30 | 1.32 | 1.29 | 1.28 | 1.32 | 1.29 |
| Cations | meq/L | | | 2.79 | 1.22 | 1.33 | 1.28 | 1.22 | 1.31 | 1.27 |
| Ionic Balance | N/A | | | 0.98 | 0.93 | 1.01 | 0.99 | 0.95 | 1.00 | 0.99 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 7.9 | 38.8 | 37.7 | 57.9 | 35.0 | 43.3 | 60.6 |
| Antimony | µg/L | | 6 | 0.213 | 0.014 | 0.007 | 0.010 | 0.008 | 0.007 | 0.011 |
| Arsenic | µg/L | 5 | 10 | 0.485 | 0.253 | 0.254 | 0.251 | 0.230 | 0.266 | 0.257 |
| Barium | µg/L | | 1000 | 2.76 | 1.86 | 1.69 | 1.96 | 1.74 | 1.68 | 2.07 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.004 | <0.003 |
| Bismuth | µg/L | | | 0.003 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Boron | µg/L | | 5000 | 26.60 | 12.90 | 12.70 | 12.00 | 12.80 | 13.80 | 12.90 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.007 | 0.002 | <0.002 | 0.002 | <0.002 | 0.003 |
| Chromium | µg/L | 1 or 16 | 50 | 0.26 | 0.22 | 0.27 | 0.26 | 0.15 | 0.34 | 0.25 |
| Cobalt | µg/L | | | 0.015 | 0.030 | 0.016 | 0.024 | 0.029 | 0.022 | 0.025 |
| Copper | µg/L | 2 - 4 | <1000 | 1.33 | 1.54 | 0.97 | 1.23 | 1.05 | 1.14 | 1.31 |
| Iron | µg/L | 300 | <300 | 90.8 | 98.2 | 57.7 | 61.8 | 94.1 | 66.4 | 65.7 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.212 | 0.010 | 0.017 | 0.026 | 0.119 | 0.046 |
| Manganese | µg/L | | <50 | 3.1 | 10.5 | 3.2 | 2.4 | 10.2 | 3.5 | 2.6 |
| Mercury | ng/L | 26 | 1000 | <0.6 | <0.6 | 1.4 | <0.6 | 1.1 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.130 | 0.094 | 0.081 | 0.104 | 0.079 | 0.082 | 0.095 |
| Nickel | µg/L | 25 - 150 | | 0.788 | 0.533 | 0.256 | 0.521 | 0.509 | 0.557 | 0.562 |
| Selenium | µg/L | 1 | 10 | 0.9 | 0.2 | 0.7 | 0.3 | <0.1 | 0.5 | 0.3 |
| Silver | µg/L | 0.1 | | 0.0052 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 45.1 | 20.1 | 20.7 | 20.5 | 19.9 | 20.8 | 20.9 |
| Thallium | µg/L | 0.8 | | 0.0006 | <0.0003 | <0.0003 | 0.0020 | <0.0003 | <0.0003 | 0.0021 |
| Tin | µg/L | | | 0.58 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | 0.04 |
| Uranium | µg/L | | 20 | 0.0295 | 0.0199 | 0.0198 | 0.0210 | 0.0192 | 0.0197 | 0.0235 |
| Vanadium | µg/L | | | <0.01 | 0.069 | 0.067 | 0.101 | 0.037 | 0.083 | 0.086 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 1.69 | 0.19 | 0.15 | 0.75 | 0.76 | 1.15 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 3.5 | 11.2 | 10.0 | 20.6 | 10.2 | 9.7 | 19.2 |
| Antimony | µg/L | | | 0.211 | 0.014 | 0.006 | 0.010 | 0.008 | 0.007 | 0.011 |
| Arsenic | µg/L | | | 0.446 | 0.229 | 0.251 | 0.250 | 0.223 | 0.262 | 0.216 |
| Barium | µg/L | | | 2.61 | 1.51 | 1.32 | 1.46 | 1.44 | 1.35 | 1.47 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 23.90 | 12.60 | 11.90 | 11.80 | 12.40 | 12.20 | 11.70 |
| Cadmium | µg/L | | | <0.002 | 0.003 | <0.002 | <0.002 | <0.002 | <0.002 | 0.003 |
| Chromium | µg/L | | | 0.26 | 0.21 | 0.27 | 0.26 | 0.15 | 0.34 | 0.25 |
| Cobalt | µg/L | | | 0.015 | 0.008 | 0.015 | 0.020 | 0.009 | 0.014 | 0.016 |
| Copper | µg/L | | | 1.32 | 1.28 | 0.96 | 1.19 | 1.04 | 1.13 | 1.10 |
| Iron | µg/L | | | 55.9 | 24.6 | 20.3 | 27.3 | 22.1 | 18.2 | 24.5 |
| Lead | µg/L | | | <0.001 | 0.030 | 0.005 | 0.006 | 0.005 | 0.005 | 0.012 |
| Manganese | µg/L | | | 1.2 | 0.8 | 0.3 | 1.2 | 0.7 | 0.4 | 1.0 |
| Molybdenum | µg/L | | | 0.126 | 0.073 | 0.079 | 0.098 | 0.072 | 0.081 | 0.094 |
| Nickel | µg/L | | | 0.757 | 0.502 | 0.253 | 0.521 | 0.452 | 0.527 | 0.520 |
| Selenium | µg/L | | | 0.8 | 0.2 | 0.6 | 0.3 | <0.1 | 0.5 | 0.2 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 44.6 | 19.1 | 20.1 | 19.9 | 19.3 | 20.3 | 19.5 |
| Uranium | µg/L | | | 0.0251 | 0.0137 | 0.0175 | 0.0195 | 0.0141 | 0.0174 | 0.0205 |
| Vanadium | µg/L | | | <0.01 | 0.068 | 0.066 | 0.099 | 0.037 | 0.082 | 0.086 |
| Zinc | µg/L | | | <0.05 | 1.11 | 0.19 | 0.15 | 0.54 | 0.75 | 0.98 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | | | |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | 0.003 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | <0.01 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Tail Outflow | | | | Glenn Lake Top | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 22-Jun-08 | 17-Jul-08 | 14-Aug-08 | 12-Sep-08 | 15-Jul-08 | 18-Aug-08 | 13-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 37.3 | 26.2 | 27.2 | 25.8 | 45.4 | 47.9 | 48.0 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 47.1 | 31.7 | 38.1 | 34.7 | 63.9 | 68.3 | 68.6 |
| Specific Conductivity (lab) | µS/cm | | | 221 | 145 | 162 | 152 | 362 | 374 | 379 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.0 | 7.1 | 7.1 | 7.2 | 7.6 | 8.2 | 8.5 |
| Total Dissolved Solids | mg/L | | <500 | 112.0 | 70.7 | 78.8 | 71.8 | 180.0 | 185.0 | 174.0 |
| Total Suspended Solids | mg/L | | | 10 | <1 | <1 | 2 | 3 | <1 | 7 |
| True Colour | TCU | | <15 | **24** | 13 | 10 | **16** | 13 | 11 | **20** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 15 | 7 | 9 | 8 | 8 | 17 | 26 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.42 | 0.30 | 0.30 | 0.33 | 0.20 | 0.23 | 0.24 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.006 | 0.009 | 0.006 | 0.008 | 0.005 | 0.008 | 0.008 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | 0.005 | 0.005 | 0.024 | <0.005 | 0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | 0.005 | 0.005 | 0.024 | <0.005 | 0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.15 | 0.08 | 0.44 | 0.27 | 0.04 | 0.26 | 0.18 |
| Dissolved Organic Carbon | mg/L | | | 7.9 | 5.1 | 6.0 | 6.5 | 3.9 | 3.6 | 3.9 |
| Total Organic Carbon | mg/L | | | 8.05 | 5.18 | 6.44 | 6.77 | 3.94 | 3.86 | 4.08 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | 1.02 | 2.41 | 1.92 |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 45 | 32 | 33 | 31 | 55 | 58 | 59 |
| Calcium (total) | mg/L | | | 8.26 | 5.53 | 6.44 | 6.05 | 11.40 | 11.40 | 12.00 |
| Calcium (extractable) | mg/L | | | 8.31 | 5.55 | 6.60 | 5.95 | 11.30 | 12.10 | 12.00 |
| Calcium (dissolved) | mg/L | | | 8.20 | 5.27 | 6.29 | 5.78 | 11.00 | 11.30 | 11.60 |
| Chloride | mg/L | | <250 | 43.9 | 27.6 | 31.1 | 28.1 | 75.2 | 79.8 | 76.3 |
| Magnesium (total) | mg/L | | | 6.47 | 4.36 | 4.93 | 4.97 | 8.76 | 9.15 | 9.71 |
| Magnesium (extractable) | mg/L | | | 6.40 | 4.33 | 5.26 | 4.82 | 8.67 | 9.26 | 9.39 |
| Magnesium (dissolved) | mg/L | | | 6.36 | 4.16 | 4.86 | 4.76 | 8.46 | 9.06 | 9.12 |
| Potassium (total) | mg/L | | | 2.150 | 1.320 | 1.350 | 1.390 | 3.450 | 3.570 | 3.960 |
| Potassium (extractable) | mg/L | | | 2.1 | 1.4 | 1.3 | 1.3 | 3.4 | | 3.3 |
| Potassium (dissolved) | mg/L | | | 2.11 | 1.26 | 1.32 | 1.33 | 3.26 | 3.37 | 3.41 |
| Sodium (total) | mg/L | | | 21.50 | 13.80 | 15.40 | 15.40 | 40.40 | 41.10 | 43.20 |
| Sodium (extractable) | mg/L | | | 23.8 | 14.1 | 16.1 | 14.2 | 41.8 | 44.5 | 36.6 |
| Sodium (dissolved) | mg/L | | | 21.30 | 13.20 | 15.25 | 14.80 | 39.10 | 40.69 | 42.30 |
| Sulfate | mg/L | | <500 | 5 | <3 | <3 | <3 | 12 | 7 | 7 |
| Anions | meq/L | | | 2.09 | 1.35 | 1.47 | 1.35 | 3.28 | 3.36 | 3.27 |
| Cations | meq/L | | | 2.03 | 1.28 | 1.50 | 1.34 | 3.18 | 3.39 | 3.05 |
| Ionic Balance | N/A | | | 0.97 | 0.95 | 1.02 | 0.99 | 0.97 | 1.01 | 0.93 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 27.2 | 11.0 | 46.0 | 25.1 | **250** | **715** | **1010** |
| Antimony | µg/L | | 6 | 0.012 | 0.008 | 0.009 | 0.007 | 0.041 | 0.039 | 0.047 |
| Arsenic | µg/L | 5 | 10 | 0.314 | 0.222 | 0.379 | 0.263 | 0.507 | 0.673 | 0.677 |
| Barium | µg/L | | 1000 | 2.58 | 2.05 | 2.92 | 1.71 | 5.54 | 11.70 | 15.90 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | 0.009 | 0.020 | 0.039 |
| Bismuth | µg/L | | | <0.001 | 0.006 | <0.001 | 0.002 | 0.002 | <0.001 | 0.006 |
| Boron | µg/L | | 5000 | 18.60 | 14.10 | 12.10 | 12.90 | 39.10 | 38.20 | 38.20 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.002 | <0.002 | 0.002 | <0.002 | 0.003 | <0.002 | 0.012 |
| Chromium | µg/L | 1 or 16 | 50 | 0.25 | 0.13 | 0.32 | 0.22 | 0.51 | **1.24** | **1.82** |
| Cobalt | µg/L | | | 0.038 | 0.021 | 0.085 | 0.051 | 0.087 | 0.225 | 0.380 |
| Copper | µg/L | 2 - 4 | <1000 | 1.26 | 0.97 | 0.95 | 1.09 | **2.68** | **2.92** | **3.78** |
| Iron | µg/L | 300 | <300 | 230 | 71.8 | **935** | 208 | 172 | **443** | **821** |
| Lead | µg/L | 1 - 7 | 10 | 0.020 | 0.017 | 0.024 | 0.007 | 0.154 | 0.232 | 0.421 |
| Manganese | µg/L | | <50 | 2.7 | 1.7 | 9.7 | 5.8 | 2.8 | 6.2 | 11.0 |
| Mercury | ng/L | 26 | 1000 | 0.8 | <0.6 | <0.6 | 0.6 | 0.8 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.112 | 0.079 | 0.086 | 0.081 | 0.627 | 0.664 | 0.663 |
| Nickel | µg/L | 25 - 150 | | 0.869 | 0.497 | 0.640 | 0.501 | 0.777 | 0.891 | 1.470 |
| Selenium | µg/L | 1 | 10 | 0.5 | <0.1 | 0.6 | 0.6 | 0.2 | **1.4** | **1.1** |
| Silver | µg/L | 0.1 | | <0.0005 | 0.0009 | 0.0010 | <0.0005 | 0.0019 | <0.0005 | 0.0077 |
| Strontium | µg/L | | | 32.5 | 22.7 | 26.6 | 22.5 | 60.9 | 64.9 | 65.6 |
| Thallium | µg/L | 0.8 | | <0.0003 | 0.0034 | 0.0017 | 0.0022 | 0.0055 | 0.0022 | 0.0162 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | 0.04 | 0.05 |
| Uranium | µg/L | | 20 | 0.0200 | 0.0107 | 0.0162 | 0.0164 | 0.2750 | 0.2660 | 0.3220 |
| Vanadium | µg/L | | | 0.080 | 0.072 | 0.162 | 0.068 | 0.551 | 1.330 | 2.110 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.09 | 0.79 | 1.15 | <0.1 | 0.86 | 1.45 | 3.58 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 8.1 | 5.2 | 9.1 | 10.6 | 31.2 | 109.0 | 88.3 |
| Antimony | µg/L | | | 0.012 | 0.008 | 0.009 | 0.007 | 0.041 | 0.038 | 0.046 |
| Arsenic | µg/L | | | 0.295 | 0.174 | 0.313 | 0.236 | 0.439 | 0.595 | 0.590 |
| Barium | µg/L | | | 2.23 | 1.84 | 2.29 | 1.41 | 3.05 | 3.99 | 3.75 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.006 | 0.003 |
| Boron | µg/L | | | 18.10 | 12.10 | 12.00 | 12.40 | 37.20 | 37.80 | 36.70 |
| Cadmium | µg/L | | | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 | <0.002 | 0.006 |
| Chromium | µg/L | | | 0.25 | 0.13 | 0.32 | 0.21 | 0.44 | 0.63 | 0.70 |
| Cobalt | µg/L | | | 0.022 | 0.015 | 0.029 | 0.021 | 0.017 | 0.039 | 0.037 |
| Copper | µg/L | | | 1.25 | 0.89 | 0.94 | 0.94 | 2.33 | 2.89 | 2.60 |
| Iron | µg/L | | | 37.0 | 29.3 | 49.1 | 34.5 | 14.6 | 58.5 | 58.2 |
| Lead | µg/L | | | 0.007 | 0.010 | 0.019 | <0.001 | 0.037 | 0.055 | 0.066 |
| Manganese | µg/L | | | 0.5 | 0.5 | 1.2 | 0.9 | 0.4 | 0.7 | 0.7 |
| Molybdenum | µg/L | | | 0.108 | 0.074 | 0.081 | 0.080 | 0.625 | 0.657 | 0.661 |
| Nickel | µg/L | | | 0.635 | 0.469 | 0.602 | 0.491 | 0.560 | 0.509 | 0.662 |
| Selenium | µg/L | | | 0.3 | <0.1 | 0.5 | 0.5 | <0.1 | 1.3 | 1.1 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 32.1 | 21.8 | 26.3 | 21.5 | 57.6 | 62.0 | 59.6 |
| Uranium | µg/L | | | 0.0156 | 0.0096 | 0.0094 | 0.0123 | 0.2380 | 0.2440 | 0.2610 |
| Vanadium | µg/L | | | 0.079 | 0.042 | 0.104 | 0.067 | 0.296 | 0.441 | 0.511 |
| Zinc | µg/L | | | 1.08 | 0.61 | 1.14 | <0.05 | 0.36 | 1.14 | 0.94 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.06 | 0.07 | 0.06 | 0.06 | 0.07 | 0.08 | 0.08 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Glenn Lake Bottom | | | Glenn Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 15-Jul-08 | 18-Aug-08 | 13-Sep-08 | 20-Jun-08 | 17-Jul-08 | 19-Aug-08 | 13-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 54.2 | 48.0 | 48.0 | 31.8 | 43.4 | 48.5 | 48.2 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 76.7 | 69.1 | 68.7 | 47.3 | 61.0 | 70.9 | 69.2 |
| Specific Conductivity (lab) | µS/cm | | | 436 | 375 | 381 | 238 | 345 | 378 | 381 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.6 | 8.2 | 8.5 | 6.8 | 7.8 | 8.1 | 8.3 |
| Total Dissolved Solids | mg/L | | <500 | 215.0 | 187.0 | 180.0 | 129.0 | 169.0 | 186.0 | 180.0 |
| Total Suspended Solids | mg/L | | | 2 | 3 | 7 | 1 | 8 | 2 | 7 |
| True Colour | TCU | | <15 | 13 | **15** | **20** | **46** | **16** | **16** | **20** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 9 | 19 | 27 | 15 | 21 | 17 | 21 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.20 | 0.22 | 0.24 | 0.40 | 0.26 | 0.24 | 0.24 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.005 | 0.008 | 0.006 | 0.008 | 0.008 | 0.006 | 0.007 |
| Nitrite+Nitrate - N | mg/L | | | 0.039 | 0.006 | 0.005 | <0.005 | <0.005 | <0.005 | 0.009 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.038 | 0.006 | 0.005 | <0.005 | <0.005 | <0.005 | 0.009 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.03 | 0.22 | 0.27 | 0.29 | 0.15 | 0.18 | 0.19 |
| Dissolved Organic Carbon | mg/L | | | 4.4 | 3.6 | 4.2 | 6.4 | 3.4 | 3.7 | 3.9 |
| Total Organic Carbon | mg/L | | | 4.43 | 3.82 | 4.47 | 6.69 | 3.55 | 3.88 | 4.09 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 66 | 58 | 59 | 39 | 53 | 59 | 59 |
| Calcium (total) | mg/L | | | 13.40 | 12.20 | 11.30 | 8.51 | 10.40 | 12.40 | 11.80 |
| Calcium (extractable) | mg/L | | | 13.40 | 12.20 | 12.00 | 8.35 | 10.70 | 12.50 | 12.20 |
| Calcium (dissolved) | mg/L | | | 13.00 | 11.90 | 11.10 | 8.25 | 10.20 | 11.90 | 11.50 |
| Chloride | mg/L | | <250 | 89.0 | 79.9 | 77.6 | 48.6 | 71.8 | 79.3 | 77.8 |
| Magnesium (total) | mg/L | | | 10.30 | 9.29 | 9.19 | 6.07 | 8.02 | 9.30 | 9.56 |
| Magnesium (extractable) | mg/L | | | 10.50 | 9.39 | 9.41 | 6.43 | 8.33 | 9.65 | 9.42 |
| Magnesium (dissolved) | mg/L | | | 10.10 | 8.93 | 8.82 | 5.90 | 7.82 | 8.97 | 9.21 |
| Potassium (total) | mg/L | | | 4.000 | 3.850 | 3.780 | 2.840 | 3.200 | 3.750 | 3.840 |
| Potassium (extractable) | mg/L | | | 4.0 | | 3.4 | 2.6 | 3.2 | | 3.4 |
| Potassium (dissolved) | mg/L | | | 3.82 | 3.45 | 3.31 | 2.70 | 2.94 | 3.44 | 3.43 |
| Sodium (total) | mg/L | | | 47.90 | 42.30 | 41.50 | 25.20 | 35.70 | 42.30 | 43.10 |
| Sodium (extractable) | mg/L | | | 50.1 | 45.5 | 43.3 | 26.7 | 39.7 | 45.5 | 42.4 |
| Sodium (dissolved) | mg/L | | | 47.30 | 42.00 | 41.10 | 24.80 | 35.34 | 41.90 | 42.80 |
| Sulfate | mg/L | | <500 | 15 | 8 | 6 | 18 | 10 | 7 | 6 |
| Anions | meq/L | | | 3.91 | 3.37 | 3.27 | 2.37 | 3.10 | 3.35 | 3.29 |
| Cations | meq/L | | | 3.82 | 3.45 | 3.34 | 2.17 | 3.03 | 3.49 | 3.32 |
| Ionic Balance | N/A | | | 0.97 | 1.02 | 1.02 | 0.91 | 0.98 | 1.04 | 1.01 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **219** | **831** | **983** | **267** | **700** | **605** | **858** |
| Antimony | µg/L | | 6 | 0.044 | 0.066 | 0.043 | 0.026 | 0.036 | 0.042 | 0.042 |
| Arsenic | µg/L | 5 | 10 | 0.682 | 0.735 | 0.653 | 0.371 | 0.674 | 0.777 | 0.696 |
| Barium | µg/L | | 1000 | 6.08 | 13.70 | 15.30 | 5.29 | 11.30 | 10.80 | 13.70 |
| Beryllium | µg/L | | | 0.006 | 0.031 | 0.030 | 0.007 | 0.023 | 0.019 | 0.024 |
| Bismuth | µg/L | | | 0.002 | 0.010 | 0.003 | 0.003 | 0.005 | 0.005 | 0.002 |
| Boron | µg/L | | 5000 | 46.40 | 41.90 | 36.50 | 26.40 | 34.80 | 42.40 | 38.20 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.004 | 0.011 | 0.004 | 0.005 | 0.007 | <0.002 | 0.004 |
| Chromium | µg/L | 1 or 16 | 50 | 0.43 | **1.34** | **1.64** | 0.52 | **1.16** | 0.96 | **1.50** |
| Cobalt | µg/L | | | 0.064 | 0.268 | 0.356 | 0.115 | 0.253 | 0.208 | 0.311 |
| Copper | µg/L | 2 - 4 | <1000 | **3.03** | **3.40** | **3.46** | **2.43** | **2.94** | **3.14** | **3.45** |
| Iron | µg/L | 300 | <300 | 120 | **571** | **776** | 204 | **535** | **427** | **675** |
| Lead | µg/L | 1 - 7 | 10 | 0.088 | 0.425 | 0.393 | 0.102 | 0.249 | 0.241 | 0.343 |
| Manganese | µg/L | | <50 | 2.6 | 8.5 | 10.3 | 5.7 | 7.8 | 6.9 | 9.5 |
| Mercury | ng/L | 26 | 1000 | 0.7 | <0.6 | <0.6 | 3.2 | <0.6 | 1.1 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.742 | 0.672 | 0.638 | 0.404 | 0.603 | 0.666 | 0.650 |
| Nickel | µg/L | 25 - 150 | | 0.751 | 1.000 | 1.360 | 0.857 | 1.170 | 0.813 | 1.260 |
| Selenium | µg/L | 1 | 10 | 0.4 | **1.5** | **1.1** | 0.5 | 0.8 | **1.7** | **1.1** |
| Silver | µg/L | 0.1 | | 0.0043 | 0.0139 | 0.0051 | <0.0005 | 0.0012 | 0.0034 | 0.0042 |
| Strontium | µg/L | | | 72.8 | 67.7 | 62.1 | 39.9 | 58.3 | 67.5 | 63.9 |
| Thallium | µg/L | 0.8 | | 0.0053 | 0.0180 | 0.0136 | 0.0034 | 0.0115 | 0.0111 | 0.0111 |
| Tin | µg/L | | | 0.05 | 0.05 | 0.05 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.3210 | 0.3180 | 0.3000 | 0.1550 | 0.2560 | 0.3080 | 0.3110 |
| Vanadium | µg/L | | | 0.494 | 1.500 | 1.940 | 0.566 | 1.350 | 1.150 | 1.770 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 0.72 | 4.64 | 2.92 | 1.79 | 1.89 | 1.55 | 2.21 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 33.1 | 112.0 | 85.3 | 55.2 | 47.9 | 107.0 | 78.8 |
| Antimony | µg/L | | | 0.044 | 0.066 | 0.042 | 0.026 | 0.036 | 0.041 | 0.041 |
| Arsenic | µg/L | | | 0.530 | 0.627 | 0.481 | 0.334 | 0.536 | 0.748 | 0.496 |
| Barium | µg/L | | | 3.78 | 4.08 | 3.47 | 2.77 | 3.02 | 4.01 | 3.50 |
| Beryllium | µg/L | | | <0.003 | 0.007 | 0.004 | <0.003 | <0.003 | 0.006 | <0.003 |
| Boron | µg/L | | | 45.30 | 40.70 | 35.80 | 24.60 | 34.30 | 40.80 | 37.50 |
| Cadmium | µg/L | | | 0.004 | 0.007 | <0.002 | 0.005 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.43 | 0.42 | 0.53 | 0.36 | 0.22 | 0.49 | 0.58 |
| Cobalt | µg/L | | | 0.009 | 0.048 | 0.033 | 0.036 | 0.021 | 0.043 | 0.032 |
| Copper | µg/L | | | 2.50 | 3.37 | 2.44 | 2.41 | 2.28 | 3.11 | 2.51 |
| Iron | µg/L | | | 8.2 | 66.0 | 49.2 | 51.1 | 30.4 | 61.6 | 46.0 |
| Lead | µg/L | | | 0.016 | 0.105 | 0.047 | 0.037 | 0.031 | 0.063 | 0.044 |
| Manganese | µg/L | | | 0.6 | 0.9 | 0.7 | 1.1 | 0.6 | 1.1 | 0.7 |
| Molybdenum | µg/L | | | 0.721 | 0.657 | 0.599 | 0.389 | 0.585 | 0.659 | 0.648 |
| Nickel | µg/L | | | 0.621 | 0.457 | 0.613 | 0.731 | 0.603 | 0.469 | 0.609 |
| Selenium | µg/L | | | 0.1 | 0.1 | 0.7 | 0.5 | 0.3 | 1.7 | 0.8 |
| Silver | µg/L | | | <0.0005 | 0.0017 | <0.0005 | <0.0005 | <0.0005 | 0.0009 | <0.0005 |
| Strontium | µg/L | | | 68.7 | 62.0 | 56.7 | 39.5 | 54.0 | 62.9 | 60.1 |
| Uranium | µg/L | | | 0.2850 | 0.2770 | 0.2450 | 0.1360 | 0.2100 | 0.2720 | 0.2540 |
| Vanadium | µg/L | | | 0.362 | 0.444 | 0.451 | 0.283 | 0.255 | 0.397 | 0.490 |
| Zinc | µg/L | | | 0.31 | 2.70 | 0.38 | 1.77 | 0.35 | 1.35 | 0.43 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.09 | 0.08 | 0.08 | 0.05 | 0.08 | 0.08 | 0.08 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Ogama Lake Top | | | | Ogama Lake Bottom | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-May-08 | 15-Jul-08 | 17-Aug-08 | 10-Sep-08 | 15-Jul-08 | 17-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 68.0 | 19.4 | 23.4 | 23.8 | 19.1 | 23.4 | 24.1 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 121.0 | 31.3 | 37.6 | 40.2 | 30.9 | 37.7 | 40.6 |
| Specific Conductivity (lab) | µS/cm | | | 725 | 184 | 225 | 229 | 184 | 225 | 230 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.9 | 7.5 | 8.0 | 7.9 | 7.5 | 8.0 | 7.9 |
| Total Dissolved Solids | mg/L | | <500 | 393.0 | 89.4 | 104.0 | 108.0 | 87.8 | 106.0 | 112.0 |
| Total Suspended Solids | mg/L | | | <1 | 4 | 5 | 8 | 4 | 2 | 8 |
| True Colour | TCU | | <15 | **37** | 13 | 12 | **36** | 13 | 12 | **36** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 25 | 20 | 25 | 29 | 19 | 35 | 36 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.72 | 0.28 | 0.47 | 0.56 | 0.28 | 0.49 | 0.55 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.011 | 0.007 | 0.006 | 0.010 | 0.008 | 0.006 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.142 | 0.018 | 0.011 | <0.005 | 0.014 | 0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.003 | 0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.139 | 0.017 | 0.011 | <0.005 | 0.013 | 0.005 | <0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.32 | 0.32 | 1.31 | 1.17 | 0.37 | 1.13 | 1.14 |
| Dissolved Organic Carbon | mg/L | | | 10.4 | 5.3 | 5.9 | 6.9 | 5.6 | 6.0 | 7.3 |
| Total Organic Carbon | mg/L | | | 10.72 | 5.62 | 7.21 | 8.07 | 5.97 | 7.13 | 8.44 |
| Chlorophyll *a* | µg/L | | | - | 2.44 | 10.22 | 6.63 | - | - | - |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 83 | 24 | 29 | 29 | 23 | 29 | 29 |
| Calcium (total) | mg/L | | | 17.70 | 4.92 | 6.13 | 6.26 | 4.89 | 6.05 | 6.28 |
| Calcium (extractable) | mg/L | | | 18.80 | 4.98 | 6.07 | 6.52 | 4.95 | 6.06 | 6.59 |
| Calcium (dissolved) | mg/L | | | 17.50 | 4.73 | 5.89 | 5.94 | 4.76 | 5.85 | 6.08 |
| Chloride | mg/L | | <250 | 197.0 | 42.2 | 47.1 | 51.6 | 42.4 | 50.1 | 54.7 |
| Magnesium (total) | mg/L | | | 17.60 | 4.38 | 5.93 | 5.61 | 4.39 | 5.84 | 5.67 |
| Magnesium (extractable) | mg/L | | | 17.90 | 4.58 | 5.45 | 5.81 | 4.51 | 5.49 | 5.87 |
| Magnesium (dissolved) | mg/L | | | 17.10 | 4.21 | 5.68 | 5.36 | 4.26 | 5.69 | 5.48 |
| Potassium (total) | mg/L | | | 5.450 | 1.790 | 2.190 | 2.030 | 1.790 | 2.180 | 2.060 |
| Potassium (extractable) | mg/L | | | 6.2 | 1.7 | | 1.8 | 1.7 | 1.9 | 1.9 |
| Potassium (dissolved) | mg/L | | | 5.20 | 1.67 | 2.04 | 1.82 | 1.69 | 2.03 | 1.84 |
| Sodium (total) | mg/L | | | 88.50 | 20.20 | 28.00 | 24.80 | 20.10 | 27.60 | 25.10 |
| Sodium (extractable) | mg/L | | | 106.0 | 20.8 | 26.8 | 25.8 | 20.7 | 26.5 | 26.5 |
| Sodium (dissolved) | mg/L | | | 88.10 | 19.60 | 27.00 | 24.00 | 19.90 | 27.20 | 24.60 |
| Sulfate | mg/L | | <500 | 6 | 3 | <3 | <3 | <3 | <3 | <3 |
| Anions | meq/L | | | 7.05 | 1.65 | 1.84 | 1.98 | 1.62 | 1.92 | 2.07 |
| Cations | meq/L | | | 7.19 | 1.58 | 1.97 | 1.97 | 1.56 | 1.96 | 2.01 |
| Ionic Balance | N/A | | | 1.02 | 0.95 | 1.07 | 1.00 | 0.96 | 1.02 | 0.97 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 46.3 | **200** | **230** | **378** | **193** | **217** | **403** |
| Antimony | µg/L | | 6 | 0.074 | 0.011 | 0.014 | 0.014 | 0.012 | 0.016 | 0.018 |
| Arsenic | µg/L | 5 | 10 | 1.360 | 0.405 | 0.583 | 0.524 | 0.394 | 0.574 | 0.560 |
| Barium | µg/L | | 1000 | 7.67 | 4.27 | 5.20 | 7.26 | 4.21 | 5.07 | 7.45 |
| Beryllium | µg/L | | | 0.004 | 0.007 | 0.011 | 0.009 | <0.003 | <0.003 | 0.009 |
| Bismuth | µg/L | | | <0.001 | 0.011 | 0.002 | 0.003 | 0.006 | 0.002 | 0.003 |
| Boron | µg/L | | 5000 | 55.80 | 14.20 | 19.30 | 16.60 | 14.40 | 19.40 | 17.20 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.004 | 0.002 | <0.002 | 0.003 | 0.004 | 0.003 |
| Chromium | µg/L | 1 or 16 | 50 | 0.48 | 0.51 | 0.42 | 0.76 | 0.50 | 0.38 | 0.79 |
| Cobalt | µg/L | | | 0.103 | 0.108 | 0.063 | 0.110 | 0.101 | 0.063 | 0.133 |
| Copper | µg/L | 2 - 4 | <1000 | **2.48** | 1.24 | 1.46 | 1.95 | 1.20 | 1.49 | 1.92 |
| Iron | µg/L | 300 | <300 | 200 | **365** | 227 | **323** | **352** | 221 | **345** |
| Lead | µg/L | 1 - 7 | 10 | 0.004 | 0.102 | 0.085 | 0.130 | 0.098 | 0.089 | 0.156 |
| Manganese | µg/L | | <50 | **81.7** | 37.9 | 11.2 | 11.7 | 36.9 | 11.1 | 12.2 |
| Mercury | ng/L | 26 | 1000 | <0.6 | 2.0 | 1.1 | <0.6 | 1.0 | 1.4 | 0.9 |
| Molybdenum | µg/L | 73 | | 0.300 | 0.133 | 0.200 | 0.200 | 0.128 | 0.190 | 0.205 |
| Nickel | µg/L | 25 - 150 | | 1.170 | 0.768 | 0.717 | 1.080 | 0.749 | 0.693 | 1.130 |
| Selenium | µg/L | 1 | 10 | 0.9 | 0.5 | **1.1** | 1.0 | 0.6 | 1.0 | 0.8 |
| Silver | µg/L | 0.1 | | 0.0054 | 0.0043 | <0.0005 | <0.0005 | 0.0045 | 0.0173 | <0.0005 |
| Strontium | µg/L | | | 116.0 | 30.3 | 37.3 | 36.6 | 30.1 | 37.0 | 37.1 |
| Thallium | µg/L | 0.8 | | 0.0004 | 0.0103 | 0.0036 | 0.0074 | 0.0059 | 0.0037 | 0.0079 |
| Tin | µg/L | | | 0.15 | <0.03 | <0.03 | <0.03 | <0.03 | 0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0765 | 0.0418 | 0.0529 | 0.0546 | 0.0405 | 0.0511 | 0.0550 |
| Vanadium | µg/L | | | <0.01 | 0.382 | 0.289 | 0.550 | 0.375 | 0.294 | 0.561 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 1.29 | 0.50 | 1.07 | 1.61 | 0.54 | 2.10 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 16.2 | 29.2 | 46.8 | 69.2 | 30.3 | 45.5 | 74.2 |
| Antimony | µg/L | | | 0.074 | 0.011 | 0.014 | 0.014 | 0.012 | 0.015 | 0.018 |
| Arsenic | µg/L | | | 1.250 | 0.286 | 0.496 | 0.434 | 0.314 | 0.484 | 0.414 |
| Barium | µg/L | | | 6.81 | 2.11 | 2.66 | 2.96 | 2.19 | 2.62 | 3.15 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.007 |
| Boron | µg/L | | | 53.70 | 13.70 | 18.80 | 16.10 | 14.10 | 19.10 | 16.50 |
| Cadmium | µg/L | | | <0.002 | 0.003 | <0.002 | <0.002 | 0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.48 | 0.35 | 0.28 | 0.42 | 0.35 | 0.27 | 0.47 |
| Cobalt | µg/L | | | 0.095 | 0.018 | 0.022 | 0.023 | 0.017 | 0.021 | 0.028 |
| Copper | µg/L | | | 2.46 | 1.12 | 1.45 | 1.44 | 1.04 | 1.48 | 1.51 |
| Iron | µg/L | | | 105.0 | 103.0 | 60.5 | 81.2 | 107.0 | 61.6 | 87.3 |
| Lead | µg/L | | | <0.001 | 0.026 | 0.032 | 0.027 | 0.028 | 0.033 | 0.037 |
| Manganese | µg/L | | | 76.5 | 9.5 | 0.5 | 0.5 | 11.6 | 0.4 | 0.6 |
| Molybdenum | µg/L | | | 0.295 | 0.123 | 0.198 | 0.183 | 0.124 | 0.176 | 0.185 |
| Nickel | µg/L | | | 1.090 | 0.564 | 0.534 | 0.810 | 0.597 | 0.522 | 0.830 |
| Selenium | µg/L | | | 0.9 | 0.5 | 0.7 | 0.7 | 0.5 | 0.2 | 0.6 |
| Silver | µg/L | | | 0.0006 | 0.0006 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 113.0 | 28.3 | 35.2 | 34.1 | 28.5 | 35.1 | 34.6 |
| Uranium | µg/L | | | 0.0680 | 0.0272 | 0.0412 | 0.0406 | 0.0307 | 0.0409 | 0.0418 |
| Vanadium | µg/L | | | <0.01 | 0.108 | 0.103 | 0.159 | 0.108 | 0.087 | 0.177 |
| Zinc | µg/L | | | <0.05 | 0.81 | 0.49 | 0.42 | 0.65 | 0.54 | 0.78 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.12 | 0.05 | 0.05 | 0.06 | 0.04 | 0.05 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Ogama Outflow | | | | Patch Lake Top | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 23-Jun-08 | 17-Jul-08 | 19-Aug-08 | 14-Sep-08 | 23-May-08 | 17-Jul-08 | 15-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 20.8 | 20.0 | 23.7 | 23.9 | 54.6 | 28.5 | 35.1 | 35.3 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 35.0 | 33.5 | 35.7 | 40.4 | 96.6 | 46.6 | 62.8 | 64.7 |
| Specific Conductivity (lab) | µS/cm | | | 211 | 193 | 227 | 230 | 486 | 273 | 334 | 340 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.8 | 7.5 | 8.0 | 8.3 | 6.6 | 7.3 | 8.0 | 7.6 |
| Total Dissolved Solids | mg/L | | <500 | 110.0 | 94.0 | 111.0 | 108.0 | 263.0 | 129.0 | 163.0 | 161.0 |
| Total Suspended Solids | mg/L | | | 4 | 3 | 4 | 6 | <1 | <1 | 2 | 3 |
| True Colour | TCU | | <15 | **57** | **25** | 12 | **36** | **15** | 13 | <1 | **17** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 23 | 28 | 32 | 28 | 8 | 8 | 9 | 9 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.48 | 0.39 | 0.51 | 0.55 | 0.30 | 0.21 | 0.23 | 0.23 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.010 | 0.005 | 0.007 | 0.008 | 0.006 | 0.008 | 0.002 | 0.005 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | 0.009 | <0.005 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.003 | 0.001 | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | 0.008 | <0.005 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.35 | 0.69 | 1.40 | 1.37 | 0.08 | 0.22 | 0.31 | 0.66 |
| Dissolved Organic Carbon | mg/L | | | 9.2 | 5.0 | 6.0 | 7.1 | 4.7 | 3.7 | 4.5 | 3.9 |
| Total Organic Carbon | mg/L | | | 9.55 | 5.69 | 7.40 | 8.47 | 4.78 | 3.92 | 4.81 | 4.56 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | 0.84 | 0.75 | 1.16 |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 25 | 24 | 29 | 29 | 67 | 35 | 43 | 43 |
| Calcium (total) | mg/L | | | 5.32 | 4.98 | 6.12 | 5.99 | 17.20 | 8.84 | 11.10 | 11.60 |
| Calcium (extractable) | mg/L | | | 5.28 | 5.03 | 5.74 | 6.41 | 17.90 | 8.72 | 11.50 | 12.20 |
| Calcium (dissolved) | mg/L | | | 5.15 | 4.82 | 6.10 | 5.93 | 16.60 | 8.84 | 11.00 | 11.10 |
| Chloride | mg/L | | <250 | 49.7 | 45.9 | 54.0 | 52.3 | 125.0 | 63.6 | 79.0 | 77.5 |
| Magnesium (total) | mg/L | | | 5.09 | 4.60 | 5.80 | 5.68 | 12.00 | 6.44 | 8.22 | 8.13 |
| Magnesium (extractable) | mg/L | | | 5.31 | 5.08 | 5.20 | 5.93 | 12.60 | 6.04 | 8.28 | 8.31 |
| Magnesium (dissolved) | mg/L | | | 4.91 | 4.50 | 5.74 | 5.60 | 11.40 | 6.16 | 8.05 | 7.82 |
| Potassium (total) | mg/L | | | 2.360 | 1.800 | 2.100 | 2.030 | 4.190 | 2.320 | 2.950 | 2.880 |
| Potassium (extractable) | mg/L | | | 2.1 | 1.7 | | 1.9 | 4.6 | 2.2 | 2.8 | 2.7 |
| Potassium (dissolved) | mg/L | | | 2.18 | 1.68 | 2.03 | 1.89 | 4.05 | 2.24 | 2.88 | 2.68 |
| Sodium (total) | mg/L | | | 24.20 | 21.50 | 25.90 | 26.00 | 56.80 | 29.00 | 38.00 | 36.80 |
| Sodium (extractable) | mg/L | | | 26.1 | 22.2 | 27.5 | 25.5 | 65.1 | 29.0 | 38.0 | 37.1 |
| Sodium (dissolved) | mg/L | | | 23.70 | 21.10 | 25.64 | 25.90 | 53.30 | 27.90 | 37.50 | 35.90 |
| Sulfate | mg/L | | <500 | 9 | <3 | <3 | <3 | 5 | <3 | <3 | <3 |
| Anions | meq/L | | | 2.01 | 1.74 | 2.04 | 2.00 | 4.72 | 2.41 | 2.97 | 2.94 |
| Cations | meq/L | | | 1.89 | 1.68 | 1.96 | 1.96 | 4.88 | 2.25 | 2.98 | 2.98 |
| Ionic Balance | N/A | | | 0.94 | 0.96 | 0.96 | 0.98 | 1.03 | 0.93 | 1.00 | 1.01 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **385** | **240** | **203** | **338** | 17.5 | **194** | 99.3 | **273** |
| Antimony | µg/L | | 6 | 0.012 | 0.012 | 0.017 | 0.015 | 0.033 | 0.014 | 0.019 | 0.043 |
| Arsenic | µg/L | 5 | 10 | 0.415 | 0.458 | 0.596 | 0.553 | 0.797 | 0.392 | 0.643 | 0.598 |
| Barium | µg/L | | 1000 | 7.50 | 5.17 | 4.91 | 6.69 | 5.11 | 4.68 | 4.36 | 6.27 |
| Beryllium | µg/L | | | 0.032 | 0.010 | <0.003 | 0.014 | <0.003 | <0.003 | <0.003 | 0.004 |
| Bismuth | µg/L | | | 0.003 | 0.002 | 0.002 | 0.002 | <0.001 | <0.001 | 0.003 | 0.004 |
| Boron | µg/L | | 5000 | 17.80 | 15.60 | 19.90 | 18.40 | 42.90 | 21.40 | 28.20 | 27.20 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.005 | 0.003 | <0.002 | 0.003 | <0.002 | <0.002 | <0.002 | 0.010 |
| Chromium | µg/L | 1 or 16 | 50 | 0.83 | 0.49 | 0.41 | 0.59 | 0.20 | 0.52 | 0.31 | 0.58 |
| Cobalt | µg/L | | | 0.205 | 0.109 | 0.066 | 0.113 | 0.008 | 0.094 | 0.037 | 0.090 |
| Copper | µg/L | 2 - 4 | <1000 | 1.69 | 1.24 | 1.39 | 1.72 | 0.96 | 1.28 | 1.15 | 1.31 |
| Iron | µg/L | 300 | <300 | **641** | **437** | 239 | **333** | 11.9 | 191 | 66.6 | 183 |
| Lead | µg/L | 1 - 7 | 10 | 0.145 | 0.087 | 0.070 | 0.108 | <0.001 | 0.089 | 0.044 | 0.155 |
| Manganese | µg/L | | <50 | 34.2 | **62.5** | 18.7 | 17.4 | 2.2 | 5.6 | 4.7 | 6.1 |
| Mercury | ng/L | 26 | 1000 | 3.1 | 1.4 | <0.6 | 1.1 | <0.6 | <0.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.269 | 0.136 | 0.231 | 0.188 | 0.208 | 0.114 | 0.158 | 0.162 |
| Nickel | µg/L | 25 - 150 | | 1.360 | 0.848 | 0.549 | 0.982 | 0.355 | 0.718 | 0.473 | 0.616 |
| Selenium | µg/L | 1 | 10 | 0.5 | 0.2 | **1.1** | 0.7 | <0.1 | 0.8 | **1.3** | **1.1** |
| Silver | µg/L | 0.1 | | 0.0006 | 0.0031 | 0.0017 | 0.0134 | 0.0010 | <0.0005 | 0.0011 | 0.0020 |
| Strontium | µg/L | | | 29.9 | 29.9 | 37.7 | 36.7 | 112.0 | 57.1 | 71.1 | 71.9 |
| Thallium | µg/L | 0.8 | | 0.0040 | 0.0040 | 0.0040 | 0.0052 | 0.0006 | <0.0003 | 0.0042 | 0.0062 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | 0.07 | <0.03 | 0.05 | 0.06 |
| Uranium | µg/L | | 20 | 0.0528 | 0.0393 | 0.0510 | 0.0586 | 0.0623 | 0.0524 | 0.0598 | 0.0615 |
| Vanadium | µg/L | | | 0.700 | 0.389 | 0.294 | 0.447 | <0.01 | 0.354 | 0.159 | 0.367 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 2.00 | 0.99 | 1.75 | 1.74 | <0.1 | 1.69 | 0.47 | 1.82 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 81.9 | 26.3 | 48.6 | 63.2 | 1.8 | 17.2 | 13.5 | 27.1 |
| Antimony | µg/L | | | 0.012 | 0.012 | 0.017 | 0.015 | 0.032 | 0.013 | 0.019 | 0.043 |
| Arsenic | µg/L | | | 0.341 | 0.322 | 0.549 | 0.518 | 0.694 | 0.383 | 0.504 | 0.429 |
| Barium | µg/L | | | 3.54 | 2.14 | 2.65 | 3.04 | 4.64 | 2.80 | 3.22 | 3.41 |
| Beryllium | µg/L | | | 0.005 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 16.40 | 14.50 | 19.40 | 17.90 | 39.60 | 18.50 | 26.80 | 25.90 |
| Cadmium | µg/L | | | 0.004 | <0.002 | <0.002 | 0.003 | <0.002 | <0.002 | <0.002 | 0.008 |
| Chromium | µg/L | | | 0.49 | 0.24 | 0.35 | 0.45 | 0.20 | 0.33 | 0.31 | 0.40 |
| Cobalt | µg/L | | | 0.086 | 0.014 | 0.020 | 0.023 | 0.008 | 0.009 | 0.015 | 0.015 |
| Copper | µg/L | | | 1.67 | 1.15 | 1.38 | 1.47 | 0.95 | 1.09 | 1.14 | 0.93 |
| Iron | µg/L | | | 316.0 | 116.0 | 75.4 | 72.7 | <2 | 24.5 | <2 | 16.5 |
| Lead | µg/L | | | 0.066 | 0.018 | 0.028 | 0.026 | <0.001 | 0.017 | 0.010 | 0.015 |
| Manganese | µg/L | | | 17.4 | 11.7 | 0.6 | 0.8 | 0.2 | 0.8 | 0.2 | 0.3 |
| Molybdenum | µg/L | | | 0.138 | 0.126 | 0.190 | 0.186 | 0.208 | 0.111 | 0.156 | 0.160 |
| Nickel | µg/L | | | 1.100 | 0.617 | 0.355 | 0.725 | 0.351 | 0.368 | 0.392 | 0.408 |
| Selenium | µg/L | | | 0.5 | <0.1 | 1.0 | 0.7 | <0.1 | 0.8 | 0.9 | 1.0 |
| Silver | µg/L | | | <0.0005 | 0.0008 | <0.0005 | 0.0007 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 28.2 | 28.4 | 37.6 | 35.2 | 110.0 | 53.7 | 69.4 | 68.5 |
| Uranium | µg/L | | | 0.0428 | 0.0292 | 0.0439 | 0.0466 | 0.0559 | 0.0411 | 0.0521 | 0.0474 |
| Vanadium | µg/L | | | 0.271 | 0.087 | 0.119 | 0.124 | <0.01 | 0.103 | 0.061 | 0.124 |
| Zinc | µg/L | | | 1.98 | 0.55 | 1.73 | 1.72 | <0.05 | 0.51 | 0.47 | 0.66 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | 0.008 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.06 | 0.05 | 0.06 | 0.06 | 0.06 | 0.05 | 0.07 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Patch Lake Bottom | | | | Patch Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 23-May-08 | 17-Jul-08 | 15-Aug-08 | 10-Sep-08 | 21-Jun-08 | 17-Jul-08 | 19-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 59.2 | 31.7 | 36.3 | 35.3 | 18.2 | 32.9 | 35.9 | 35.2 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 103.0 | 52.2 | 62.8 | 65.6 | 31.6 | 55.3 | 62.8 | 68.6 |
| Specific Conductivity (lab) | µS/cm | | | 526 | 300 | 335 | 341 | 169 | 318 | 340 | 342 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.6 | 7.3 | 8.0 | 7.6 | 7.0 | 7.6 | 8.2 | 8.0 |
| Total Dissolved Solids | mg/L | | <500 | 285.0 | 141.0 | 162.0 | 162.0 | 87.6 | 151.0 | 166.0 | 164.0 |
| Total Suspended Solids | mg/L | | | <1 | <1 | 1 | 4 | <1 | <1 | <1 | 2 |
| True Colour | TCU | | <15 | 6 | 13 | <1 | **17** | **29** | <1 | 4 | **17** |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 6 | 8 | 8 | 12 | 13 | 9 | 9 | 8 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.32 | 0.23 | 0.24 | 0.24 | 0.27 | 0.25 | 0.20 | 0.22 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.017 | 0.005 | 0.004 | 0.007 | 0.005 | 0.005 | 0.007 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.031 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.014 | 0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.029 | 0.005 | <0.005 | <0.005 | <0.005 | <0.005 | 0.014 | 0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | <0.02 | 0.24 | 0.21 | 0.12 | 0.20 | 0.14 | 0.13 | <0.02 |
| Dissolved Organic Carbon | mg/L | | | 4.8 | 4.3 | 4.4 | 3.8 | 5.5 | 3.4 | 4.2 | 4.0 |
| Total Organic Carbon | mg/L | | | 4.81 | 4.54 | 4.61 | 3.92 | 5.70 | 3.54 | 4.33 | 3.99 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 72 | 39 | 44 | 43 | 22 | 40 | 44 | 43 |
| Calcium (total) | mg/L | | | 18.60 | 10.00 | 11.30 | 11.70 | 5.59 | 10.70 | 11.60 | 11.80 |
| Calcium (extractable) | mg/L | | | 19.00 | 9.82 | 11.50 | 12.30 | 5.51 | 10.50 | 12.10 | 12.90 |
| Calcium (dissolved) | mg/L | | | 17.80 | 9.85 | 11.00 | 11.30 | 5.46 | 10.60 | 11.30 | 11.40 |
| Chloride | mg/L | | <250 | 136.0 | 68.9 | 77.6 | 78.7 | 39.6 | 74.9 | 81.0 | 79.2 |
| Magnesium (total) | mg/L | | | 13.00 | 7.23 | 8.37 | 8.19 | 4.23 | 7.31 | 7.81 | 8.23 |
| Magnesium (extractable) | mg/L | | | 13.40 | 6.73 | 8.28 | 8.48 | 4.33 | 7.07 | 7.91 | 8.83 |
| Magnesium (dissolved) | mg/L | | | 12.80 | 6.87 | 8.14 | 7.99 | 4.12 | 7.14 | 7.75 | 7.90 |
| Potassium (total) | mg/L | | | 4.480 | 2.550 | 3.000 | 2.900 | 1.940 | 2.700 | 2.880 | 2.850 |
| Potassium (extractable) | mg/L | | | 4.9 | 2.4 | 2.8 | 2.8 | 1.8 | 2.7 | | 2.7 |
| Potassium (dissolved) | mg/L | | | 4.48 | 2.46 | 2.88 | 2.73 | 1.85 | 2.60 | 2.76 | 2.72 |
| Sodium (total) | mg/L | | | 60.60 | 33.20 | 38.90 | 37.00 | 18.20 | 33.10 | 35.80 | 37.30 |
| Sodium (extractable) | mg/L | | | 70.3 | 31.8 | 37.6 | 36.9 | 18.7 | 34.5 | 38.5 | 36.8 |
| Sodium (dissolved) | mg/L | | | 59.70 | 31.10 | 37.60 | 36.30 | 17.70 | 32.50 | 35.20 | 36.10 |
| Sulfate | mg/L | | <500 | 6 | <3 | <3 | <3 | 7 | <3 | <3 | <3 |
| Anions | meq/L | | | 5.15 | 2.62 | 2.96 | 2.97 | 1.62 | 2.81 | 3.05 | 2.98 |
| Cations | meq/L | | | 5.23 | 2.49 | 2.96 | 2.99 | 1.49 | 2.67 | 3.00 | 3.04 |
| Ionic Balance | N/A | | | 1.02 | 0.95 | 1.00 | 1.01 | 0.92 | 0.95 | 0.99 | 1.02 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 36.3 | **104** | **101** | **240** | 95.3 | **199** | **144** | **159** |
| Antimony | µg/L | | 6 | 0.078 | 0.014 | 0.026 | 0.021 | 0.013 | 0.018 | 0.019 | 0.018 |
| Arsenic | µg/L | 5 | 10 | 0.806 | 0.393 | 0.673 | 0.551 | 0.265 | 0.475 | 0.653 | 0.557 |
| Barium | µg/L | | 1000 | 5.70 | 3.98 | 4.42 | 5.72 | 3.12 | 5.49 | 4.97 | 4.90 |
| Beryllium | µg/L | | | 0.009 | 0.004 | 0.004 | 0.003 | 0.006 | 0.007 | 0.003 | <0.003 |
| Bismuth | µg/L | | | 0.002 | <0.001 | 0.003 | 0.002 | 0.004 | 0.003 | 0.003 | <0.001 |
| Boron | µg/L | | 5000 | 43.30 | 23.70 | 28.80 | 27.40 | 13.90 | 23.10 | 27.30 | 27.30 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | <0.002 | 0.003 | <0.002 | 0.004 | <0.002 | <0.002 | 0.003 |
| Chromium | µg/L | 1 or 16 | 50 | 0.23 | 0.33 | 0.34 | 0.52 | 0.31 | 0.53 | 0.48 | 0.35 |
| Cobalt | µg/L | | | 0.014 | 0.056 | 0.041 | 0.077 | 0.179 | 0.087 | 0.055 | 0.049 |
| Copper | µg/L | 2 - 4 | <1000 | 1.15 | 1.13 | 1.10 | 1.17 | 0.84 | 1.17 | 1.05 | 1.06 |
| Iron | µg/L | 300 | <300 | 37.8 | 113 | 70.6 | 165 | 177 | 186 | 119 | 101 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.049 | 0.046 | 0.088 | 0.051 | 0.081 | 0.044 | 0.060 |
| Manganese | µg/L | | <50 | 5.5 | 5.3 | 4.8 | 5.5 | 20.5 | 5.6 | 5.3 | 4.1 |
| Mercury | ng/L | 26 | 1000 | 0.9 | <0.6 | <0.6 | <0.6 | 2.6 | <0.6 | <0.6 | 0.6 |
| Molybdenum | µg/L | 73 | | 0.195 | 0.111 | 0.163 | 0.157 | 0.131 | 0.138 | 0.174 | 0.156 |
| Nickel | µg/L | 25 - 150 | | 0.296 | 0.592 | 0.610 | 0.530 | 0.575 | 0.579 | 0.221 | 0.442 |
| Selenium | µg/L | 1 | 10 | <0.1 | 0.2 | **1.5** | **1.3** | 0.5 | 0.2 | **1.6** | **1.1** |
| Silver | µg/L | 0.1 | | 0.0069 | 0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0028 | 0.0007 | 0.0016 |
| Strontium | µg/L | | | 120.0 | 63.6 | 71.8 | 72.4 | 31.6 | 66.3 | 74.0 | 72.9 |
| Thallium | µg/L | 0.8 | | 0.0019 | <0.0003 | 0.0036 | 0.0062 | 0.0022 | 0.0066 | 0.0087 | 0.0045 |
| Tin | µg/L | | | 1.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0613 | 0.0475 | 0.0599 | 0.0599 | 0.0314 | 0.0618 | 0.0632 | 0.0553 |
| Vanadium | µg/L | | | 0.052 | 0.158 | 0.116 | 0.332 | 0.179 | 0.363 | 0.277 | 0.198 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 0.74 | 0.84 | 0.66 | 2.12 | 0.93 | 0.86 | 0.65 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 3.8 | 11.0 | 13.3 | 24.9 | 25.5 | 11.5 | 18.7 | 21.0 |
| Antimony | µg/L | | | 0.078 | 0.014 | 0.025 | 0.021 | 0.012 | 0.018 | 0.019 | 0.018 |
| Arsenic | µg/L | | | 0.726 | 0.385 | 0.589 | 0.467 | 0.233 | 0.395 | 0.591 | 0.452 |
| Barium | µg/L | | | 5.15 | 2.91 | 3.22 | 3.27 | 2.26 | 3.31 | 3.43 | 3.19 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 | <0.003 | 0.004 | 0.003 | <0.003 |
| Boron | µg/L | | | 42.20 | 21.00 | 27.00 | 26.30 | 12.60 | 21.80 | 26.00 | 26.10 |
| Cadmium | µg/L | | | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.23 | 0.32 | 0.34 | 0.41 | 0.29 | 0.28 | 0.39 | 0.31 |
| Cobalt | µg/L | | | 0.002 | 0.005 | 0.014 | 0.009 | 0.121 | 0.006 | 0.014 | 0.030 |
| Copper | µg/L | | | 1.14 | 0.99 | 1.09 | 0.95 | 0.83 | 0.96 | 1.04 | 1.05 |
| Iron | µg/L | | | 2.0 | 15.4 | 2.0 | 14.8 | 96.4 | 18.1 | 17.2 | 12.2 |
| Lead | µg/L | | | <0.001 | 0.014 | 0.005 | 0.012 | 0.033 | 0.007 | 0.009 | 0.009 |
| Manganese | µg/L | | | 0.8 | 1.0 | 0.2 | 0.3 | 14.9 | 0.3 | 0.2 | 0.3 |
| Molybdenum | µg/L | | | 0.189 | 0.103 | 0.154 | 0.155 | 0.119 | 0.131 | 0.172 | 0.154 |
| Nickel | µg/L | | | 0.268 | 0.368 | 0.579 | 0.408 | 0.541 | 0.381 | 0.161 | 0.416 |
| Selenium | µg/L | | | 0.2 | 0.1 | 1.1 | 0.8 | 0.3 | 0.1 | 1.4 | 1.0 |
| Silver | µg/L | | | 0.0047 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 116.0 | 60.7 | 69.2 | 69.2 | 30.4 | 64.4 | 71.6 | 69.8 |
| Uranium | µg/L | | | 0.0527 | 0.0389 | 0.0511 | 0.0493 | 0.0309 | 0.0482 | 0.0550 | 0.0475 |
| Vanadium | µg/L | | | 0.030 | 0.066 | 0.086 | 0.112 | 0.127 | 0.064 | 0.054 | 0.093 |
| Zinc | µg/L | | | <0.05 | 0.73 | 0.83 | 0.65 | 2.10 | 0.42 | 0.85 | 0.64 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | 0.005 | <0.005 | 0.007 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.08 | 0.06 | 0.07 | 0.07 | 0.04 | 0.06 | 0.07 | 0.07 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Pelvic Lake Top | | | Pelvic Lake Bottom | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 15-Jul-08 | 17-Aug-08 | 11-Sep-08 | 15-Jul-08 | 17-Aug-08 | 11-Sep-08 |
| **Physical** | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 18.6 | 20.9 | 20.6 | 30.7 | 21.0 | 20.6 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 30.4 | 33.1 | 34.4 | 44.7 | 33.6 | 35.1 |
| Specific Conductivity (lab) | µS/cm | | | 200 | 227 | 226 | 343 | 227 | 226 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.3 | 8.0 | 7.6 | 7.3 | 8.0 | 7.6 |
| Total Dissolved Solids | mg/L | | <500 | 97.8 | 110.0 | 107.0 | 165.0 | 109.0 | 107.0 |
| Total Suspended Solids | mg/L | | | 6 | 8 | 10 | 5 | 9 | 11 |
| True Colour | TCU | | <15 | 13 | 12 | **26** | **42** | 12 | **22** |
| **Nutrients** | | | | | | | | | |
| Total Phosphorus | µg/L | | | 32 | 51 | 49 | 102 | 44 | 45 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.45 | 0.70 | 0.87 | 0.86 | 0.71 | 0.84 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.007 | 0.006 | 0.011 | 0.360 | 0.005 | 0.005 |
| Nitrite+Nitrate - N | mg/L | | | 0.015 | <0.005 | <0.005 | 0.031 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | <0.001 | <0.001 | <0.001 | 0.003 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.015 | <0.005 | <0.005 | 0.028 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 1.17 | 2.69 | 2.68 | 1.30 | 2.55 | 3.74 |
| Dissolved Organic Carbon | mg/L | | | 5.1 | 5.7 | 6.3 | 6.9 | 6.2 | 6.1 |
| Total Organic Carbon | mg/L | | | 6.27 | 8.39 | 8.98 | 8.20 | 8.75 | 9.84 |
| Chlorophyll *a* | µg/L | | | 6.39 | 19.48 | 18.43 | - | - | - |
| **Major Ions** | | | | | | | | | |
| Bicarbonate | mg/L | | | 23 | 25 | 25 | 37 | 26 | 25 |
| Calcium (total) | mg/L | | | 3.80 | 4.21 | 4.40 | 5.66 | 4.27 | 4.26 |
| Calcium (extractable) | mg/L | | | 3.78 | 4.23 | 4.43 | 5.76 | 4.30 | 4.52 |
| Calcium (dissolved) | mg/L | | | 3.64 | 4.06 | 4.07 | 5.52 | 4.06 | 4.06 |
| Chloride | mg/L | | <250 | 47.1 | 54.6 | 53.2 | 80.8 | 54.5 | 52.5 |
| Magnesium (total) | mg/L | | | 4.86 | 5.58 | 5.67 | 7.10 | 5.65 | 5.47 |
| Magnesium (extractable) | mg/L | | | 5.09 | 5.47 | 5.66 | 7.37 | 5.55 | 5.78 |
| Magnesium (dissolved) | mg/L | | | 4.73 | 5.43 | 5.30 | 7.06 | 5.39 | 5.25 |
| Potassium (total) | mg/L | | | 1.720 | 1.920 | 1.960 | 2.510 | 1.950 | 1.890 |
| Potassium (extractable) | mg/L | | | 1.6 | 1.8 | 1.7 | 2.7 | 1.8 | 1.7 |
| Potassium (dissolved) | mg/L | | | 1.60 | 1.76 | 1.70 | 2.40 | 1.76 | 1.70 |
| Sodium (total) | mg/L | | | 24.10 | 28.10 | 27.80 | 36.90 | 28.70 | 26.90 |
| Sodium (extractable) | mg/L | | | 24.2 | 29.2 | 27.8 | 43.1 | 28.6 | 27.8 |
| Sodium (dissolved) | mg/L | | | 23.80 | 27.10 | 26.30 | 36.60 | 27.60 | 26.00 |
| Sulfate | mg/L | | <500 | 5 | <3 | <3 | 6 | <3 | <3 |
| Anions | meq/L | | | 1.80 | 2.00 | 1.96 | 3.03 | 2.00 | 1.94 |
| Cations | meq/L | | | 1.70 | 1.98 | 1.94 | 2.86 | 1.96 | 1.96 |
| Ionic Balance | N/A | | | 0.95 | 0.99 | 0.99 | 0.95 | 0.98 | 1.01 |
| **Total Metals** | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **191** | **141** | **239** | **139** | **145** | **246** |
| Antimony | µg/L | | 6 | 0.013 | 0.014 | 0.016 | 0.020 | 0.015 | 0.016 |
| Arsenic | µg/L | 5 | 10 | 0.538 | 0.635 | 0.576 | 1.060 | 0.636 | 0.563 |
| Barium | µg/L | | 1000 | 4.27 | 3.65 | 4.59 | 5.15 | 3.70 | 4.74 |
| Beryllium | µg/L | | | 0.004 | <0.003 | <0.003 | 0.004 | 0.006 | 0.008 |
| Bismuth | µg/L | | | 0.001 | 0.002 | 0.002 | <0.001 | 0.003 | 0.002 |
| Boron | µg/L | | 5000 | 20.10 | 20.80 | 21.00 | 28.30 | 21.40 | 20.10 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | <0.002 | <0.002 | 0.002 | 0.002 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.42 | 0.36 | 0.54 | 0.37 | 0.35 | 0.49 |
| Cobalt | µg/L | | | 0.077 | 0.067 | 0.082 | 0.224 | 0.067 | 0.083 |
| Copper | µg/L | 2 - 4 | <1000 | 1.42 | 1.38 | 1.69 | 1.66 | 1.38 | 1.59 |
| Iron | µg/L | 300 | <300 | 291 | **329** | 252 | **1950** | **327** | 260 |
| Lead | µg/L | 1 - 7 | 10 | 0.071 | 0.062 | 0.083 | 0.081 | 0.059 | 0.100 |
| Manganese | µg/L | | <50 | 30.3 | 23.8 | 11.7 | **268.0** | 24.2 | 13.2 |
| Mercury | ng/L | 26 | 1000 | <0.6 | 1.1 | <0.6 | 0.9 | 1.3 | 1.0 |
| Molybdenum | µg/L | 73 | | 0.107 | 0.124 | 0.143 | 0.137 | 0.124 | 0.147 |
| Nickel | µg/L | 25 - 150 | | 0.509 | 0.645 | 0.617 | 0.417 | 0.450 | 0.614 |
| Selenium | µg/L | 1 | 10 | 0.4 | 1.0 | 0.9 | 0.4 | 1.0 | 0.8 |
| Silver | µg/L | 0.1 | | 0.0022 | 0.0028 | <0.0005 | 0.0024 | <0.0005 | 0.0005 |
| Strontium | µg/L | | | 26.9 | 29.6 | 30.3 | 41.0 | 29.6 | 29.1 |
| Thallium | µg/L | 0.8 | | 0.0030 | 0.0048 | 0.0047 | 0.0030 | 0.0043 | 0.0049 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0422 | 0.0464 | 0.0509 | 0.0517 | 0.0478 | 0.0534 |
| Vanadium | µg/L | | | 0.254 | 0.221 | 0.360 | 0.309 | 0.235 | 0.363 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 0.74 | 0.35 | 0.46 | 1.04 | 0.27 | 0.56 |
| **Dissolved Metals** | | | | | | | | | |
| Aluminum | µg/L | | | 26.2 | 27.4 | 44.7 | 14.6 | 28.4 | 43.6 |
| Antimony | µg/L | | | 0.013 | 0.014 | 0.016 | 0.020 | 0.015 | 0.016 |
| Arsenic | µg/L | | | 0.453 | 0.527 | 0.461 | 0.914 | 0.516 | 0.459 |
| Barium | µg/L | | | 2.12 | 1.92 | 2.07 | 2.98 | 1.91 | 2.03 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | 0.004 | 0.004 | <0.003 |
| Boron | µg/L | | | 19.30 | 19.40 | 18.70 | 27.40 | 19.70 | 19.20 |
| Cadmium | µg/L | | | 0.002 | <0.002 | <0.002 | <0.002 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.31 | 0.28 | 0.33 | 0.37 | 0.24 | 0.32 |
| Cobalt | µg/L | | | 0.016 | 0.019 | 0.020 | 0.021 | 0.021 | 0.019 |
| Copper | µg/L | | | 1.33 | 1.37 | 1.29 | 1.64 | 1.37 | 1.32 |
| Iron | µg/L | | | 80.7 | 136.0 | 85.0 | 1260.0 | 133.0 | 85.7 |
| Lead | µg/L | | | 0.014 | 0.014 | 0.082 | 0.080 | 0.020 | 0.019 |
| Manganese | µg/L | | | 2.5 | 0.3 | 0.3 | 25.9 | 0.3 | 0.3 |
| Molybdenum | µg/L | | | 0.091 | 0.102 | 0.103 | 0.122 | 0.098 | 0.109 |
| Nickel | µg/L | | | 0.197 | 0.100 | 0.129 | 0.250 | 0.100 | 0.156 |
| Selenium | µg/L | | | 0.4 | 0.9 | 0.7 | 0.4 | 0.2 | 0.6 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 25.4 | 28.4 | 27.4 | 40.2 | 28.0 | 27.3 |
| Uranium | µg/L | | | 0.0312 | 0.0361 | 0.0391 | 0.0358 | 0.0366 | 0.0364 |
| Vanadium | µg/L | | | 0.045 | 0.076 | 0.101 | 0.222 | 0.099 | 0.126 |
| Zinc | µg/L | | | 0.47 | 0.35 | 0.25 | 1.03 | 0.26 | 0.06 |
| **Radionuclides** | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | 0.007 | <0.005 | 0.008 | <0.005 | <0.005 |
| **Other** | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.05 | 0.05 | 0.05 | 0.06 | 0.05 | 0.05 |
| Sulphide | mg/L | | | <0.001 | <0.001 | 0.001 | 0.001 | 0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Pelvic Outflow | | | | P.O. Lake | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 21-Jun-08 | 17-Jul-08 | 19-Aug-08 | 11-Sep-08 | 14-Jul-08 | 17-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 11.8 | 19.7 | 20.8 | 20.3 | 21.8 | 29.3 | 30.4 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 18.4 | 30.6 | 31.1 | 33.6 | 38.2 | 49.3 | 53.4 |
| Specific Conductivity (lab) | µS/cm | | | 105 | 216 | 229 | 226 | 216 | 288 | 301 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.1 | 7.4 | **8.7** | 7.8 | 7.7 | 7.8 | 7.9 |
| Total Dissolved Solids | mg/L | | <500 | 53.0 | 106.0 | 110.0 | 105.0 | 104.0 | 139.0 | 142.0 |
| Total Suspended Solids | mg/L | | | 2 | 6 | 10 | 16 | 3 | 3 | 6 |
| True Colour | TCU | | <15 | **57** | 13 | 12 | **22** | 13 | <1 | **17** |
| **Nutrients** | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 34 | 47 | 55 | 67 | 19 | 12 | 22 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.50 | 0.53 | 0.82 | 0.99 | 0.20 | 0.20 | 0.28 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.005 | 0.016 | 0.006 | 0.005 | 0.008 | 0.006 | 0.007 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | 0.012 | <0.005 | 0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.002 | <0.001 | <0.001 | <0.001 | 0.007 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | 0.005 | <0.005 | 0.005 |
| **Organics** | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.51 | 1.61 | 3.44 | 3.95 | 0.05 | 0.16 | 0.26 |
| Dissolved Organic Carbon | mg/L | | | 7.9 | 5.1 | 5.6 | 6.0 | 4.0 | 4.0 | 4.3 |
| Total Organic Carbon | mg/L | | | 8.41 | 6.71 | 9.04 | 9.95 | 4.05 | 4.16 | 4.56 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | 0.85 | 1.55 | 1.70 |
| **Major Ions** | | | | | | | | | | |
| Bicarbonate | mg/L | | | 14 | 24 | 25 | 25 | 27 | 36 | 37 |
| Calcium (total) | mg/L | | | 2.50 | 3.89 | 4.31 | 4.25 | 6.62 | 8.78 | 9.04 |
| Calcium (extractable) | mg/L | | | 2.47 | 3.93 | 3.97 | 4.31 | 6.64 | 8.73 | 9.35 |
| Calcium (dissolved) | mg/L | | | 2.44 | 3.69 | 4.20 | 4.04 | 6.33 | 8.62 | 8.66 |
| Chloride | mg/L | | <250 | 22.6 | 51.9 | 54.8 | 53.4 | 51.1 | 67.9 | 69.1 |
| Magnesium (total) | mg/L | | | 2.85 | 5.05 | 5.83 | 5.49 | 5.24 | 7.02 | 6.89 |
| Magnesium (extractable) | mg/L | | | 2.97 | 5.04 | 5.14 | 5.54 | 5.25 | 6.67 | 7.31 |
| Magnesium (dissolved) | mg/L | | | 2.75 | 4.84 | 5.62 | 5.28 | 5.04 | 6.91 | 6.76 |
| Potassium (total) | mg/L | | | 1.380 | 1.800 | 2.010 | 2.010 | 2.230 | 2.780 | 2.720 |
| Potassium (extractable) | mg/L | | | 1.2 | 1.8 | | 1.7 | 2.2 | 2.5 | 2.3 |
| Potassium (dissolved) | mg/L | | | 1.30 | 1.64 | 1.83 | 1.73 | 2.13 | 2.60 | 2.29 |
| Sodium (total) | mg/L | | | 11.90 | 25.60 | 28.60 | 27.30 | 24.30 | 34.40 | 31.40 |
| Sodium (extractable) | mg/L | | | 12.3 | 26.8 | 30.0 | 26.1 | 24.0 | 33.7 | 33.8 |
| Sodium (dissolved) | mg/L | | | 11.80 | 24.80 | 27.90 | 26.60 | 23.70 | 33.90 | 31.09 |
| Sulfate | mg/L | | <500 | 4 | 5 | <3 | <3 | <3 | <3 | <3 |
| Anions | meq/L | | | 0.97 | 1.96 | 2.01 | 1.96 | 1.92 | 2.55 | 2.60 |
| Cations | meq/L | | | 0.93 | 1.82 | 1.97 | 1.85 | 1.86 | 2.52 | 2.60 |
| Ionic Balance | N/A | | | 0.97 | 0.93 | 0.98 | 0.95 | 0.97 | 0.99 | 1.00 |
| **Total Metals** | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **195** | **186** | **236** | **394** | **158** | **394** | **923** |
| Antimony | µg/L | | 6 | 0.009 | 0.017 | 0.030 | 0.017 | 0.017 | 0.023 | 0.023 |
| Arsenic | µg/L | 5 | 10 | 0.228 | 0.590 | 0.746 | 0.659 | 0.353 | 0.600 | 0.610 |
| Barium | µg/L | | 1000 | 4.14 | 4.32 | 4.60 | 6.62 | 3.19 | 6.87 | 14.10 |
| Beryllium | µg/L | | | 0.012 | 0.005 | 0.009 | 0.013 | 0.003 | 0.007 | 0.027 |
| Bismuth | µg/L | | | 0.002 | 0.002 | 0.002 | 0.002 | <0.001 | 0.003 | 0.008 |
| Boron | µg/L | | 5000 | 11.90 | 20.70 | 23.70 | 20.20 | 17.60 | 25.70 | 22.10 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.006 | 0.002 | <0.002 | <0.002 | 0.013 | 0.004 | 0.004 |
| Chromium | µg/L | 1 or 16 | 50 | 0.48 | 0.39 | 0.44 | 0.67 | 0.38 | 0.52 | **1.54** |
| Cobalt | µg/L | | | 0.173 | 0.088 | 0.079 | 0.139 | 0.069 | 0.081 | 0.259 |
| Copper | µg/L | 2 - 4 | <1000 | 1.35 | 1.37 | 1.46 | 1.99 | 1.20 | 1.29 | 1.95 |
| Iron | µg/L | 300 | <300 | **321** | **504** | 270 | **362** | 162 | 207 | **581** |
| Lead | µg/L | 1 - 7 | 10 | 0.065 | 0.076 | 0.085 | 0.160 | 0.208 | 0.151 | 0.344 |
| Manganese | µg/L | | <50 | 35.4 | **54.9** | 15.2 | 20.7 | 5.2 | 8.7 | 10.1 |
| Mercury | ng/L | 26 | 1000 | 4.1 | <0.6 | <0.6 | <0.6 | 1.5 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.083 | 0.114 | 0.270 | 0.161 | 0.121 | 0.205 | 0.245 |
| Nickel | µg/L | 25 - 150 | | 0.801 | 0.584 | 0.386 | 0.795 | 0.520 | 0.522 | 1.090 |
| Selenium | µg/L | 1 | 10 | 0.3 | 0.3 | **1.1** | 0.9 | 0.6 | **1.2** | **1.3** |
| Silver | µg/L | 0.1 | | <0.0005 | 0.0014 | 0.0028 | <0.0005 | <0.0005 | 0.0018 | 0.0128 |
| Strontium | µg/L | | | 14.7 | 27.6 | 31.4 | 30.0 | 40.7 | 56.1 | 57.7 |
| Thallium | µg/L | 0.8 | | 0.0020 | 0.0038 | 0.0038 | 0.0066 | 0.0030 | 0.0054 | 0.0150 |
| Tin | µg/L | | | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | <0.03 | 0.13 |
| Uranium | µg/L | | 20 | 0.0393 | 0.0399 | 0.0574 | 0.0613 | 0.0487 | 0.0643 | 0.0800 |
| Vanadium | µg/L | | | 0.339 | 0.284 | 0.396 | 0.607 | 0.251 | 0.403 | 1.330 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 1.70 | 2.07 | 0.81 | 1.58 | 2.66 | 1.03 | 2.72 |
| **Dissolved Metals** | | | | | | | | | | |
| Aluminum | µg/L | | | 64.0 | 17.2 | 46.0 | 40.0 | 21.7 | 64.1 | 104.0 |
| Antimony | µg/L | | | 0.009 | 0.016 | 0.030 | 0.016 | 0.017 | 0.023 | 0.023 |
| Arsenic | µg/L | | | 0.215 | 0.442 | 0.648 | 0.484 | 0.305 | 0.437 | 0.402 |
| Barium | µg/L | | | 2.43 | 1.95 | 2.10 | 2.05 | 1.70 | 2.45 | 2.88 |
| Beryllium | µg/L | | | 0.008 | <0.003 | 0.009 | 0.003 | <0.003 | <0.003 | 0.003 |
| Boron | µg/L | | | 11.50 | 18.90 | 21.80 | 19.30 | 16.90 | 24.30 | 22.10 |
| Cadmium | µg/L | | | 0.006 | 0.002 | <0.002 | <0.002 | 0.007 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.36 | 0.20 | 0.27 | 0.29 | 0.25 | 0.29 | 0.48 |
| Cobalt | µg/L | | | 0.067 | 0.015 | 0.028 | 0.022 | 0.012 | 0.024 | 0.031 |
| Copper | µg/L | | | 1.34 | 1.10 | 1.45 | 1.42 | 0.99 | 1.28 | 1.20 |
| Iron | µg/L | | | 164.0 | 165.0 | 103.0 | 61.4 | 25.7 | 29.1 | 66.6 |
| Lead | µg/L | | | 0.030 | 0.076 | 0.038 | 0.021 | 0.037 | 0.047 | 0.044 |
| Manganese | µg/L | | | 12.4 | 0.5 | 0.4 | 0.3 | 0.3 | 0.4 | 0.6 |
| Molybdenum | µg/L | | | 0.082 | 0.086 | 0.115 | 0.110 | 0.107 | 0.202 | 0.235 |
| Nickel | µg/L | | | 0.694 | 0.447 | 0.005 | 0.131 | 0.343 | 0.400 | 0.501 |
| Selenium | µg/L | | | 0.3 | <0.1 | 1.0 | 0.5 | 0.6 | 0.8 | 0.9 |
| Silver | µg/L | | | <0.0005 | 0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 14.6 | 25.6 | 30.4 | 27.6 | 38.7 | 55.9 | 52.1 |
| Uranium | µg/L | | | 0.0357 | 0.0271 | 0.0449 | 0.0399 | 0.0362 | 0.0492 | 0.0467 |
| Vanadium | µg/L | | | 0.152 | 0.075 | 0.155 | 0.119 | 0.069 | 0.088 | 0.239 |
| Zinc | µg/L | | | 1.68 | 0.75 | 0.80 | 0.24 | 2.55 | 1.02 | 0.58 |
| **Radionuclides** | | | | | | | | | | |
| Radium-226 | Bq/L | | | 0.020 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.03 | 0.06 | 0.05 | 0.05 | 0.04 | 0.06 | 0.06 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | P.O. Outflow | | | | Windy Lake Top | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 21-Jun-08 | 17-Jul-08 | 19-Aug-08 | 10-Sep-08 | 24-May-08 | 20-Jul-08 | 19-Aug-08 | 14-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 29.8 | 22.8 | 29.6 | 30.3 | 58.2 | 49.0 | 49.1 | 49.1 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 52.6 | 37.2 | 48.3 | 53.6 | 81.1 | 66.5 | 65.5 | 72.9 |
| Specific Conductivity (lab) | µS/cm | | | 290 | 226 | 290 | 300 | 478 | 433 | 429 | 435 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.4 | 7.6 | 8.1 | 7.9 | 7.4 | 7.7 | 8.4 | 8.1 |
| Total Dissolved Solids | mg/L | | <500 | 151.0 | 109.0 | 142.0 | 143.0 | 263.0 | 211.0 | 210.0 | 211.0 |
| Total Suspended Solids | mg/L | | | 2 | 5 | <1 | 5 | <1 | <1 | <1 | <1 |
| True Colour | TCU | | <15 | **46** | 11 | 8 | **17** | 4 | <1 | <1 | 13 |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 14 | 17 | 14 | 18 | 4 | 5 | 6 | 6 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.34 | 0.23 | 0.23 | 0.28 | 0.15 | 0.15 | 0.11 | 0.12 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.006 | 0.004 | 0.005 | 0.009 | 0.004 | 0.007 | 0.005 | 0.002 |
| Nitrite+Nitrate - N | mg/L | | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.003 | <0.001 | <0.001 | <0.001 | 0.001 | <0.001 | <0.001 | 0.002 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.24 | 0.30 | 0.15 | 0.15 | <0.02 | <0.02 | 0.15 | <0.02 |
| Dissolved Organic Carbon | mg/L | | | 8.2 | 3.5 | 3.9 | 4.2 | 1.7 | 1.8 | 1.5 | 1.9 |
| Total Organic Carbon | mg/L | | | 8.44 | 3.80 | 4.05 | 4.35 | 1.71 | 1.81 | 1.65 | 1.91 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | 0.39 | 8.19 | 0.53 |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 36 | 28 | 36 | 37 | 71 | 60 | 60 | 60 |
| Calcium (total) | mg/L | | | 9.06 | 6.60 | 8.84 | 8.83 | 12.90 | 11.30 | 11.50 | 11.30 |
| Calcium (extractable) | mg/L | | | 8.87 | 6.51 | 8.58 | 9.43 | 13.70 | 11.30 | 11.30 | 12.80 |
| Calcium (dissolved) | mg/L | | | 8.75 | 6.52 | 8.71 | 8.74 | 12.70 | 11.00 | 11.30 | 10.90 |
| Chloride | mg/L | | <250 | 69.6 | 53.8 | 70.0 | 69.7 | 117.0 | 95.9 | 97.2 | 96.8 |
| Magnesium (total) | mg/L | | | 7.14 | 5.22 | 6.67 | 6.76 | 9.43 | 9.43 | 9.26 | 9.92 |
| Magnesium (extractable) | mg/L | | | 7.39 | 5.09 | 6.54 | 7.31 | 11.40 | 9.29 | 9.06 | 9.94 |
| Magnesium (dissolved) | mg/L | | | 6.91 | 5.09 | 6.62 | 6.65 | 9.34 | 9.11 | 9.14 | 9.51 |
| Potassium (total) | mg/L | | | 3.270 | 2.380 | 2.630 | 2.590 | 4.220 | 3.730 | 3.810 | 3.960 |
| Potassium (extractable) | mg/L | | | 2.9 | 2.2 | | 2.3 | 4.9 | 3.8 | | 3.9 |
| Potassium (dissolved) | mg/L | | | 3.11 | 2.20 | 2.50 | 2.29 | 4.13 | 3.60 | 3.73 | 3.76 |
| Sodium (total) | mg/L | | | 32.90 | 23.70 | 32.20 | 31.40 | 51.90 | 52.30 | 51.20 | 55.60 |
| Sodium (extractable) | mg/L | | | 33.8 | 25.5 | 34.8 | 33.7 | 71.4 | 53.5 | 54.9 | 53.6 |
| Sodium (dissolved) | mg/L | | | 32.10 | 23.46 | 32.00 | 31.40 | 51.90 | 50.80 | 50.50 | 53.50 |
| Sulfate | mg/L | | <500 | 11 | <3 | <3 | <3 | 10 | 8 | 4 | 5 |
| Anions | meq/L | | | 2.79 | 2.02 | 2.61 | 2.62 | 4.67 | 3.86 | 3.82 | 3.82 |
| Cations | meq/L | | | 2.59 | 1.91 | 2.54 | 2.60 | 4.85 | 3.75 | 3.79 | 3.89 |
| Ionic Balance | N/A | | | 0.93 | 0.95 | 0.97 | 0.99 | 1.04 | 0.97 | 0.99 | 1.02 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **226** | **564** | **299** | **718** | 4.4 | 61.1 | 92.1 | 67.2 |
| Antimony | µg/L | | 6 | 0.016 | 0.014 | 0.019 | 0.018 | 0.142 | 0.058 | 0.061 | 0.064 |
| Arsenic | µg/L | 5 | 10 | 0.480 | 0.517 | 0.616 | 0.550 | 0.673 | 0.589 | 0.761 | 0.605 |
| Barium | µg/L | | 1000 | 5.51 | 7.94 | 5.38 | 11.40 | 2.14 | 2.54 | 3.02 | 2.68 |
| Beryllium | µg/L | | | 0.005 | 0.020 | 0.008 | 0.013 | <0.003 | 0.003 | 0.005 | 0.004 |
| Bismuth | µg/L | | | 0.004 | 0.004 | 0.002 | 0.005 | <0.001 | <0.001 | 0.001 | 0.007 |
| Boron | µg/L | | 5000 | 24.40 | 16.70 | 25.00 | 22.00 | 54.40 | 50.50 | 47.90 | 48.00 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.006 | <0.002 | <0.002 | 0.002 | <0.002 | 0.009 | 0.003 | 0.004 |
| Chromium | µg/L | 1 or 16 | 50 | 0.48 | **1.09** | 0.43 | **1.13** | 0.20 | 0.33 | 0.40 | 0.30 |
| Cobalt | µg/L | | | 0.134 | 0.195 | 0.094 | 0.192 | 0.003 | 0.026 | 0.030 | 0.022 |
| Copper | µg/L | 2 - 4 | <1000 | 1.22 | 1.23 | 1.09 | 1.60 | 0.49 | 1.04 | 0.85 | 1.52 |
| Iron | µg/L | 300 | <300 | 264 | **483** | 195 | **440** | 4.0 | 50.6 | 63.0 | 41.7 |
| Lead | µg/L | 1 - 7 | 10 | 0.090 | 0.196 | 0.090 | 0.252 | <0.001 | 0.038 | 0.031 | 0.033 |
| Manganese | µg/L | | <50 | 21.7 | 10.0 | 20.0 | 9.2 | 0.8 | 2.3 | 2.8 | 2.3 |
| Mercury | ng/L | 26 | 1000 | 3.0 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | <0.6 | 0.6 |
| Molybdenum | µg/L | 73 | | 0.170 | 0.122 | 0.208 | 0.207 | 0.756 | 0.629 | 1.150 | 0.665 |
| Nickel | µg/L | 25 - 150 | | 0.906 | 0.803 | 0.243 | 0.836 | 0.031 | 0.161 | 0.005 | 0.110 |
| Selenium | µg/L | 1 | 10 | 0.8 | 0.5 | **1.4** | **1.3** | 0.3 | 0.3 | **2.0** | **1.2** |
| Silver | µg/L | 0.1 | | <0.0005 | 0.0344 | 0.0015 | <0.0005 | 0.0035 | 0.0014 | <0.0005 | 0.0038 |
| Strontium | µg/L | | | 52.3 | 41.5 | 57.2 | 56.2 | 70.0 | 58.7 | 58.3 | 57.8 |
| Thallium | µg/L | 0.8 | | 0.0029 | 0.0105 | 0.0055 | 0.0132 | 0.0010 | 0.0029 | 0.0065 | 0.0065 |
| Tin | µg/L | | | <0.03 | 0.04 | <0.03 | <0.03 | 1.28 | 0.07 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.0619 | 0.0660 | 0.0612 | 0.0703 | 0.2200 | 0.1890 | 0.1860 | 0.1850 |
| Vanadium | µg/L | | | 0.343 | 0.988 | 0.322 | 0.996 | <0.01 | 0.097 | 0.133 | 0.087 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 2.45 | 1.56 | 1.25 | 1.52 | <0.1 | 0.57 | 0.35 | 0.62 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 51.1 | 35.6 | 63.2 | 96.2 | 1.7 | 3.2 | 6.4 | 4.8 |
| Antimony | µg/L | | | 0.016 | 0.014 | 0.018 | 0.018 | 0.141 | 0.057 | 0.060 | 0.063 |
| Arsenic | µg/L | | | 0.396 | 0.368 | 0.582 | 0.402 | 0.565 | 0.481 | 0.636 | 0.455 |
| Barium | µg/L | | | 3.40 | 1.74 | 2.24 | 2.79 | 2.12 | 1.93 | 2.08 | 1.96 |
| Beryllium | µg/L | | | 0.005 | <0.003 | 0.006 | <0.003 | <0.003 | 0.003 | 0.005 | <0.003 |
| Boron | µg/L | | | 22.60 | 16.40 | 24.50 | 21.80 | 53.80 | 46.20 | 46.10 | 45.20 |
| Cadmium | µg/L | | | 0.004 | <0.002 | <0.002 | <0.002 | <0.002 | 0.002 | <0.002 | 0.004 |
| Chromium | µg/L | | | 0.39 | 0.23 | 0.31 | 0.46 | 0.20 | 0.22 | 0.40 | 0.29 |
| Cobalt | µg/L | | | 0.070 | 0.014 | 0.018 | 0.027 | <0.001 | 0.002 | 0.009 | 0.005 |
| Copper | µg/L | | | 1.21 | 1.22 | 1.08 | 1.19 | 0.48 | 0.75 | 0.84 | 0.77 |
| Iron | µg/L | | | 102.0 | 45.4 | 37.6 | 57.7 | <2 | <2 | 2.1 | <2 |
| Lead | µg/L | | | 0.039 | 0.020 | 0.021 | 0.037 | <0.001 | 0.005 | 0.009 | 0.033 |
| Manganese | µg/L | | | 14.8 | 0.3 | 0.3 | 0.5 | 0.1 | 0.1 | 0.1 | 0.1 |
| Molybdenum | µg/L | | | 0.169 | 0.114 | 0.199 | 0.205 | 0.748 | 0.621 | 0.711 | 0.628 |
| Nickel | µg/L | | | 0.716 | 0.360 | 0.099 | 0.446 | 0.030 | 0.098 | 0.005 | 0.075 |
| Selenium | µg/L | | | 0.7 | 0.2 | 1.3 | 0.8 | 0.3 | 0.2 | 1.8 | 0.8 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 | 0.0029 | <0.0005 | <0.0005 | 0.0006 |
| Strontium | µg/L | | | 51.8 | 39.4 | 55.1 | 52.4 | 67.6 | 56.5 | 57.4 | 55.1 |
| Uranium | µg/L | | | 0.0523 | 0.0386 | 0.0491 | 0.0445 | 0.2190 | 0.1780 | 0.1750 | 0.1700 |
| Vanadium | µg/L | | | 0.153 | 0.096 | 0.123 | 0.237 | 0.012 | 0.023 | 0.060 | 0.086 |
| Zinc | µg/L | | | 2.43 | 0.69 | 0.92 | 0.32 | <0.05 | 0.26 | 0.35 | 0.62 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.06 | 0.05 | 0.06 | 0.06 | 0.08 | 0.08 | 0.08 | 0.09 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Windy Lake Bottom | | | | Windy Outflow | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 24-May-08 | 20-Jul-08 | 19-Aug-08 | 14-Sep-08 | 22-Jun-08 | 17-Jul-08 | 19-Aug-08 | 14-Sep-08 |
| **Physical** | | | | | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 59.0 | 48.7 | 49.1 | 49.1 | 27.5 | 39.5 | 49.6 | 48.7 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 82.5 | 68.6 | 66.0 | 72.7 | 39.3 | 53.8 | 71.3 | 73.0 |
| Specific Conductivity (lab) | µS/cm | | | 484 | 437 | 431 | 435 | 230 | 343 | 430 | 434 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 7.4 | 7.7 | 8.4 | 8.1 | 7.5 | 7.5 | 8.0 | 8.0 |
| Total Dissolved Solids | mg/L | | <500 | 268.0 | 215.0 | 212.0 | 213.0 | 118.0 | 167.0 | 212.0 | 210.0 |
| Total Suspended Solids | mg/L | | | <1 | <1 | <1 | <1 | 1 | <1 | <1 | <1 |
| True Colour | TCU | | <15 | <1 | <1 | <1 | 10 | **18** | 3 | <1 | 10 |
| **Nutrients** | | | | | | | | | | | |
| Total Phosphorus | µg/L | | | 4 | 11 | 8 | 6 | 7 | 11 | 8 | 7 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.15 | 0.13 | 0.13 | 0.16 | 0.16 | 0.17 | 0.13 | 0.12 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.004 | 0.007 | 0.005 | 0.004 | 0.004 | 0.005 | 0.004 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.016 | 0.005 | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.001 | <0.001 | <0.001 | 0.001 | 0.001 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.015 | 0.005 | 0.010 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| **Organics** | | | | | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 0.03 | 0.04 | 0.14 | 0.07 | <0.02 | 0.07 | 0.18 | 0.06 |
| Dissolved Organic Carbon | mg/L | | | 1.5 | 1.8 | 1.6 | 2.2 | 2.6 | 1.7 | 1.8 | 2.0 |
| Total Organic Carbon | mg/L | | | 1.53 | 1.84 | 1.74 | 2.27 | 2.60 | 1.77 | 1.98 | 2.06 |
| Chlorophyll *a* | µg/L | | | - | - | - | - | - | - | - | - |
| **Major Ions** | | | | | | | | | | | |
| Bicarbonate | mg/L | | | 72 | 59 | 60 | 60 | 33 | 48 | 60 | 59 |
| Calcium (total) | mg/L | | | 13.10 | 11.30 | 11.70 | 11.20 | 7.04 | 9.24 | 12.10 | 11.70 |
| Calcium (extractable) | mg/L | | | 13.90 | 11.60 | 11.40 | 12.70 | 6.74 | 9.35 | 12.20 | 12.80 |
| Calcium (dissolved) | mg/L | | | 12.60 | 10.80 | 11.20 | 10.90 | 6.62 | 8.73 | 11.70 | 10.80 |
| Chloride | mg/L | | <250 | 119.0 | 96.8 | 97.8 | 96.6 | 50.5 | 76.3 | 95.2 | 95.8 |
| Magnesium (total) | mg/L | | | 9.51 | 9.03 | 9.33 | 9.77 | 5.38 | 7.40 | 9.94 | 10.10 |
| Magnesium (extractable) | mg/L | | | 11.60 | 9.63 | 9.12 | 9.95 | 5.46 | 7.40 | 9.93 | 9.97 |
| Magnesium (dissolved) | mg/L | | | 9.31 | 8.94 | 9.06 | 9.52 | 5.04 | 7.00 | 9.58 | 9.28 |
| Potassium (total) | mg/L | | | 4.210 | 3.580 | 3.870 | 3.910 | 2.250 | 2.920 | 4.010 | 4.040 |
| Potassium (extractable) | mg/L | | | 4.9 | 3.8 | | 3.8 | 1.9 | 3.0 | | 3.8 |
| Potassium (dissolved) | mg/L | | | 4.11 | 3.54 | 3.71 | 3.79 | 2.08 | 2.75 | 3.86 | 3.71 |
| Sodium (total) | mg/L | | | 51.90 | 50.60 | 52.00 | 54.70 | 27.80 | 39.80 | 54.90 | 56.40 |
| Sodium (extractable) | mg/L | | | 72.6 | 54.5 | 56.5 | 54.3 | 27.8 | 42.4 | 56.5 | 54.6 |
| Sodium (dissolved) | mg/L | | | 51.90 | 50.09 | 50.80 | 53.90 | 26.30 | 37.80 | 53.40 | 52.00 |
| Sulfate | mg/L | | <500 | 10 | 10 | 4 | 7 | 9 | 5 | 4 | 4 |
| Anions | meq/L | | | 4.77 | 3.91 | 3.84 | 3.85 | 2.16 | 3.05 | 3.77 | 3.75 |
| Cations | meq/L | | | 4.93 | 3.84 | 3.87 | 3.91 | 2.04 | 2.99 | 3.98 | 3.93 |
| Ionic Balance | N/A | | | 1.03 | 0.98 | 1.01 | 1.02 | 0.95 | 0.98 | 1.06 | 1.05 |
| **Total Metals** | | | | | | | | | | | |
| Aluminum | µg/L | 5, 100 | | 14.0 | 59.7 | **107** | 69.8 | **159** | **112** | 46.6 | 57.9 |
| Antimony | µg/L | | 6 | 0.074 | 0.061 | 0.067 | 0.061 | 0.036 | 0.049 | 0.064 | 0.124 |
| Arsenic | µg/L | 5 | 10 | 0.698 | 0.603 | 0.825 | 0.651 | 0.284 | 0.456 | 0.757 | 0.658 |
| Barium | µg/L | | 1000 | 2.67 | 2.45 | 3.22 | 2.76 | 3.01 | 3.00 | 2.61 | 3.11 |
| Beryllium | µg/L | | | <0.003 | <0.003 | 0.005 | <0.003 | 0.005 | 0.004 | <0.003 | 0.005 |
| Bismuth | µg/L | | | <0.001 | <0.001 | <0.001 | 0.004 | 0.002 | 0.002 | 0.004 | 0.007 |
| Boron | µg/L | | 5000 | 57.30 | 47.80 | 48.40 | 47.30 | 25.40 | 37.40 | 52.60 | 48.50 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | <0.002 | 0.004 | 0.002 | 0.004 | 0.004 | <0.002 | <0.002 | **0.036** |
| Chromium | µg/L | 1 or 16 | 50 | 0.27 | 0.19 | 0.44 | 0.31 | 0.39 | 0.30 | 0.31 | 0.35 |
| Cobalt | µg/L | | | 0.009 | 0.027 | 0.037 | 0.024 | 0.057 | 0.057 | 0.018 | 0.028 |
| Copper | µg/L | 2 - 4 | <1000 | 0.35 | 0.97 | 0.84 | 1.02 | 0.97 | 0.92 | 0.83 | 1.04 |
| Iron | µg/L | 300 | <300 | 13.5 | 47.5 | 79.2 | 46.4 | 121 | 166 | 44.4 | 49.1 |
| Lead | µg/L | 1 - 7 | 10 | <0.001 | 0.039 | 0.084 | 0.048 | 0.072 | 0.157 | 0.023 | 0.247 |
| Manganese | µg/L | | <50 | 1.1 | 2.2 | 3.2 | 2.4 | 1.9 | 5.1 | 1.5 | 2.8 |
| Mercury | ng/L | 26 | 1000 | <0.6 | <0.6 | <0.6 | <0.6 | 1.4 | <0.6 | <0.6 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.748 | 0.613 | 0.683 | 0.643 | 0.346 | 0.498 | 0.674 | 0.656 |
| Nickel | µg/L | 25 - 150 | | 0.052 | 0.192 | 0.005 | 0.127 | 0.373 | 0.219 | 0.005 | 0.174 |
| Selenium | µg/L | 1 | 10 | 0.5 | 0.4 | **2.3** | **1.3** | 0.6 | 0.3 | **2.2** | **1.3** |
| Silver | µg/L | 0.1 | | 0.0041 | <0.0005 | <0.0005 | 0.0021 | 0.0011 | 0.0006 | 0.0036 | 0.0032 |
| Strontium | µg/L | | | 70.0 | 57.9 | 59.6 | 56.9 | 32.7 | 46.5 | 61.4 | 59.2 |
| Thallium | µg/L | 0.8 | | 0.0011 | 0.0026 | 0.0070 | 0.0050 | 0.0027 | 0.0040 | 0.0069 | 0.0042 |
| Tin | µg/L | | | 0.15 | <0.03 | <0.03 | 0.04 | <0.03 | 0.97 | <0.03 | <0.03 |
| Uranium | µg/L | | 20 | 0.2110 | 0.1830 | 0.1940 | 0.1770 | 0.0993 | 0.1050 | 0.2020 | 0.1980 |
| Vanadium | µg/L | | | <0.01 | 0.056 | 0.124 | 0.126 | 0.259 | 0.173 | 0.023 | 0.055 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | <0.1 | 3.43 | 0.51 | 0.70 | 0.76 | 0.86 | 0.22 | 3.90 |
| **Dissolved Metals** | | | | | | | | | | | |
| Aluminum | µg/L | | | 1.9 | 3.1 | 6.5 | 4.9 | 39.4 | 3.9 | 8.3 | 6.7 |
| Antimony | µg/L | | | 0.073 | 0.060 | 0.067 | 0.061 | 0.035 | 0.049 | 0.063 | 0.123 |
| Arsenic | µg/L | | | 0.640 | 0.544 | 0.693 | 0.588 | 0.261 | 0.344 | 0.653 | 0.545 |
| Barium | µg/L | | | 2.41 | 1.93 | 2.09 | 1.98 | 1.62 | 1.70 | 2.07 | 2.17 |
| Beryllium | µg/L | | | <0.003 | <0.003 | 0.003 | <0.003 | 0.003 | <0.003 | <0.003 | 0.005 |
| Boron | µg/L | | | 53.80 | 47.80 | 47.30 | 46.10 | 23.20 | 34.60 | 50.10 | 44.40 |
| Cadmium | µg/L | | | <0.002 | <0.002 | <0.002 | 0.004 | 0.003 | <0.002 | <0.002 | 0.025 |
| Chromium | µg/L | | | 0.27 | 0.19 | 0.42 | 0.31 | 0.33 | 0.16 | 0.31 | 0.34 |
| Cobalt | µg/L | | | 0.009 | 0.004 | 0.011 | 0.006 | 0.026 | 0.004 | 0.014 | 0.007 |
| Copper | µg/L | | | 0.34 | 0.96 | 0.83 | 0.77 | 0.96 | 0.70 | 0.82 | 0.78 |
| Iron | µg/L | | | 8.5 | <2 | <2 | <2 | 29.3 | 8.7 | 9.6 | <2 |
| Lead | µg/L | | | <0.001 | 0.007 | 0.004 | <0.001 | 0.021 | 0.007 | 0.008 | 0.021 |
| Manganese | µg/L | | | 0.1 | 0.1 | 0.1 | 0.1 | 0.3 | 0.3 | 0.3 | 0.4 |
| Molybdenum | µg/L | | | 0.741 | 0.607 | 0.673 | 0.637 | 0.310 | 0.460 | 0.661 | 0.632 |
| Nickel | µg/L | | | 0.052 | 0.190 | 0.005 | 0.092 | 0.253 | 0.160 | 0.005 | 0.107 |
| Selenium | µg/L | | | 0.5 | 2.0 | 0.4 | 1.2 | 0.5 | <0.1 | 1.8 | 1.2 |
| Silver | µg/L | | | 0.0027 | <0.0005 | <0.0005 | 0.0012 | <0.0005 | <0.0005 | 0.0010 | 0.0009 |
| Strontium | µg/L | | | 68.6 | 56.3 | 57.9 | 55.5 | 30.9 | 43.5 | 58.5 | 54.0 |
| Uranium | µg/L | | | 0.1990 | 0.1720 | 0.1770 | 0.1710 | 0.0814 | 0.0801 | 0.1800 | 0.1730 |
| Vanadium | µg/L | | | <0.01 | <0.01 | 0.016 | 0.099 | 0.131 | <0.01 | 0.023 | 0.055 |
| Zinc | µg/L | | | <0.05 | 0.52 | 0.51 | 0.60 | 0.75 | 0.46 | 0.22 | 2.45 |
| **Radionuclides** | | | | | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | 0.007 | <0.005 | <0.005 | <0.005 | <0.005 | 0.008 | <0.005 |
| **Other** | | | | | | | | | | | |
| Cyanide | mg/L | | 0.2 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.10 | 0.09 | 0.08 | 0.09 | 0.04 | 0.07 | 0.08 | 0.09 |
| Sulphide | mg/L | | | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# Appendix B5. Analytical results for freshwater water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | CDWG - Drinking Water[a] | Wolverine Lake | | | |
|---|---|---|---|---|---|---|---|
| | | | | 23-May-08 | 14-Jul-08 | 15-Aug-08 | 10-Sep-08 |
| **Physical** | | | | | | | |
| Alkalinity (Total as $CaCO_3$) | mg/L | | | 117 | 32.1 | 36.6 | 36.5 |
| Hardness (Total as $CaCO_3$) | mg/L | | | 181.0 | 48.9 | 57.8 | 58.0 |
| Specific Conductivity (lab) | µS/cm | | | 999 | 300 | 246 | 348 |
| Field pH | pH Unit | 6.5 - 9.0 | 6.5 - 8.5 | 6.7 | 7.8 | 8.3 | 7.9 |
| Total Dissolved Solids | mg/L | | <500 | **560.0** | 147.0 | 171.0 | 164.0 |
| Total Suspended Solids | mg/L | | | 5 | 5 | <1 | 2 |
| True Colour | TCU | | <15 | **15** | 11 | 8 | **20** |
| **Nutrients** | | | | | | | |
| Total Phosphorus | µg/L | | | 35 | 15 | 19 | 11 |
| Total Kjeldahl Nitrogen | mg/L | | | 0.88 | 0.33 | 0.33 | 0.37 |
| Ammonia - N | mg/L | 0.2 - 122.4 | | 0.009 | 0.011 | 0.004 | 0.006 |
| Nitrite+Nitrate - N | mg/L | | | 0.011 | 0.014 | 0.005 | <0.005 |
| Nitrite - N | mg/L | 0.06 | 3.2 | 0.006 | <0.001 | <0.001 | <0.001 |
| Nitrate - N (calculated) | mg/L | 2.9 | 10 | 0.005 | 0.014 | 0.005 | <0.005 |
| **Organics** | | | | | | | |
| Organic Carbon (particulate) | mg/L | | | 1.05 | 0.21 | 0.37 | 0.18 |
| Dissolved Organic Carbon | mg/L | | | 9.7 | 4.9 | 5.8 | 5.2 |
| Total Organic Carbon | mg/L | | | 10.75 | 5.11 | 6.17 | 5.38 |
| Chlorophyll *a* | µg/L | | | - | 1.48 | 1.55 | 1.88 |
| **Major Ions** | | | | | | | |
| Bicarbonate | mg/L | | | 142 | 39 | 45 | 44 |
| Calcium (total) | mg/L | | | 24.40 | 7.23 | 8.29 | 8.02 |
| Calcium (extractable) | mg/L | | | 25.80 | 7.05 | 8.50 | 8.39 |
| Calcium (dissolved) | mg/L | | | 24.20 | 6.86 | 8.00 | 7.79 |
| Chloride | mg/L | | <250 | **275.0** | 72.0 | 83.5 | 81.6 |
| Magnesium (total) | mg/L | | | 25.00 | 7.85 | 9.23 | 8.83 |
| Magnesium (extractable) | mg/L | | | 28.40 | 7.59 | 8.88 | 9.01 |
| Magnesium (dissolved) | mg/L | | | 24.75 | 7.50 | 8.94 | 8.47 |
| Potassium (total) | mg/L | | | 6.000 | 2.020 | 2.360 | 2.070 |
| Potassium (extractable) | mg/L | | | 6.5 | | 2.2 | 2.1 |
| Potassium (dissolved) | mg/L | | | 5.98 | 1.92 | 2.27 | 1.97 |
| Sodium (total) | mg/L | | | 147.26 | 37.70 | 46.50 | 42.90 |
| Sodium (extractable) | mg/L | | | 150.0 | 36.9 | 44.2 | 39.2 |
| Sodium (dissolved) | mg/L | | | 143.09 | 36.20 | 45.40 | 41.60 |
| Sulfate | mg/L | | <500 | 4 | <3 | <3 | <3 |
| Anions | meq/L | | | 10.20 | 2.72 | 3.13 | 3.08 |
| Cations | meq/L | | | 10.30 | 2.63 | 3.13 | 2.92 |
| Ionic Balance | N/A | | | 1.01 | 0.97 | 1.00 | 0.95 |
| **Total Metals** | | | | | | | |
| Aluminum | µg/L | 5, 100 | | **205** | 67.0 | 46.5 | 87.2 |
| Antimony | µg/L | | 6 | 0.077 | 0.016 | 0.012 | 0.010 |
| Arsenic | µg/L | 5 | 10 | 1.820 | 0.490 | 0.738 | 0.521 |
| Barium | µg/L | | 1000 | 18.00 | 4.56 | 4.22 | 4.35 |
| Beryllium | µg/L | | | 0.005 | <0.003 | <0.003 | <0.003 |
| Bismuth | µg/L | | | 0.004 | <0.001 | <0.001 | 0.002 |
| Boron | µg/L | | 5000 | 49.80 | 16.70 | 20.90 | 19.40 |
| Cadmium | µg/L | 0.007 - 0.055 | 5 | 0.005 | **0.020** | 0.004 | <0.002 |
| Chromium | µg/L | 1 or 16 | 50 | 0.67 | 0.22 | 0.16 | 0.28 |
| Cobalt | µg/L | | | 0.437 | 0.059 | 0.030 | 0.032 |
| Copper | µg/L | 2 - 4 | <1000 | 0.31 | 1.09 | 0.62 | 0.65 |
| Iron | µg/L | 300 | <300 | **729** | 178 | 91.4 | 81.9 |
| Lead | µg/L | 1 - 7 | 10 | 0.081 | 0.231 | 0.023 | 0.038 |
| Manganese | µg/L | | <50 | **565.0** | 32.2 | 13.1 | 6.6 |
| Mercury | ng/L | 26 | 1000 | <0.6 | 2.3 | 1.3 | <0.6 |
| Molybdenum | µg/L | 73 | | 0.067 | 0.066 | 0.084 | 0.083 |
| Nickel | µg/L | 25 - 150 | | 0.863 | 0.426 | 0.285 | 0.525 |
| Selenium | µg/L | 1 | 10 | 0.9 | 0.6 | **1.5** | 1.0 |
| Silver | µg/L | 0.1 | | 0.0132 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 137.0 | 36.3 | 42.5 | 42.0 |
| Thallium | µg/L | 0.8 | | 0.0033 | <0.0003 | 0.0025 | 0.0045 |
| Tin | µg/L | | | 0.55 | <0.03 | 0.03 | 0.07 |
| Uranium | µg/L | | 20 | 0.0475 | 0.0254 | 0.0279 | 0.0265 |
| Vanadium | µg/L | | | 0.170 | 0.081 | 0.039 | 0.145 |
| Zinc | µg/L | 30, 13 - 198 | <5000 | 0.18 | 2.92 | 0.30 | 3.53 |
| **Dissolved Metals** | | | | | | | |
| Aluminum | µg/L | | | 1.1 | 8.6 | 7.4 | 10.8 |
| Antimony | µg/L | | | 0.076 | 0.016 | 0.012 | 0.010 |
| Arsenic | µg/L | | | 1.750 | 0.427 | 0.627 | 0.414 |
| Barium | µg/L | | | 15.40 | 3.68 | 3.35 | 3.30 |
| Beryllium | µg/L | | | <0.003 | <0.003 | <0.003 | <0.003 |
| Boron | µg/L | | | 44.90 | 15.50 | 19.80 | 17.90 |
| Cadmium | µg/L | | | 0.002 | 0.007 | <0.002 | <0.002 |
| Chromium | µg/L | | | 0.66 | 0.22 | 0.16 | 0.28 |
| Cobalt | µg/L | | | 0.342 | 0.011 | 0.012 | 0.013 |
| Copper | µg/L | | | 0.30 | 0.83 | 0.62 | 0.51 |
| Iron | µg/L | | | 121.0 | 26.9 | 8.6 | 17.5 |
| Lead | µg/L | | | <0.001 | 0.038 | 0.001 | 0.002 |
| Manganese | µg/L | | | 527.0 | 1.5 | 0.2 | 0.2 |
| Molybdenum | µg/L | | | 0.060 | 0.057 | 0.077 | 0.082 |
| Nickel | µg/L | | | 0.702 | 0.335 | 0.260 | 0.309 |
| Selenium | µg/L | | | 0.9 | 0.5 | 1.1 | 0.7 |
| Silver | µg/L | | | <0.0005 | <0.0005 | <0.0005 | <0.0005 |
| Strontium | µg/L | | | 132.0 | 35.2 | 40.9 | 39.9 |
| Uranium | µg/L | | | 0.0336 | 0.0178 | 0.0268 | 0.0210 |
| Vanadium | µg/L | | | 0.016 | 0.032 | 0.019 | 0.086 |
| Zinc | µg/L | | | 0.17 | 1.27 | 0.30 | 0.05 |
| **Radionuclides** | | | | | | | |
| Radium-226 | Bq/L | | | <0.005 | <0.005 | <0.005 | <0.005 |
| **Other** | | | | | | | |
| Cyanide | mg/L | | 0.2 | 0.001 | <0.001 | <0.001 | <0.001 |
| Fluoride | mg/L | | 1.5 | 0.14 | 0.08 | 0.07 | 0.06 |
| Sulphide | mg/L | | | 0.001 | <0.001 | <0.001 | <0.001 |

[a]Guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# APPENDIX B6

# FRESHWATER EXCEEDENCES OF WATER QUALITY AND DRINKING WATER GUIDELINES, 2003 - 2008

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Aimaokatalok Lake Site 4 | 17-Aug-06 | Top | 7.0 | 11.3 | | | **0.006** | | | | | | | | | | |
| | 24-May-07 | Top | 7.0 | 15.1 | | | **0.024** | | | **2.3** | | | | | | | |
| | 24-May-07 | Bottom | 7.0 | 14.4 | | | **0.009** | **1.2** | | | | | | | | | |
| | 21-Jul-07 | Top | **6.0** | 12.3 | | **31.7** | | | | | | | | | | | |
| | 19-Aug-07 | Top | **6.2** | 12.4 | | **43.7** | | | | | | | | | | | |
| | 8-Sep-07 | Top | **6.0** | 13.2 | | **42.9** | | | | | | | | | | | |
| Aimaokatalok Lake Site 6 | 3-Jun-06 | Bottom | - | 17.6 | | **192** | | | | | | | | | | | |
| | 20-Jul-07 | Top | **6.0** | 12.1 | | **36.2** | | | | | | | | | | | |
| | 19-Aug-07 | Top | **6.1** | 12.4 | | **48.1** | | | | | | | | | | | |
| | 8-Sep-07 | Top | **6.1** | 13.5 | | **59.8** | | | | | | | | | | | |
| Fickle Duck Lake | 18-Jul-06 | Top | 7.0 | 17.8 | | **122** | | | | | **364** | | | | | | |
| | 17-Aug-06 | Top | 8.0 | 22.6 | | | | | | | **501** | | | | | | |
| | 10-Sep-06 | Top | 7.7 | 25.5 | | **172** | | | | | **532** | | | | | | |
| | 24-May-07 | Top | 6.9 | 104 | | | | **1.8** | | **2.6** | **2810** | **187** | | | | | |
| | 22-Jul-07 | Top | 7.3 | 21.1 | | **114** | | | | | **357** | | | | | | |
| | 20-Aug-07 | Top | 6.8 | 26.5 | | **155** | | | | | **317** | | | | | | |
| | 9-Sep-07 | Top | 6.6 | 29.0 | | **112** | | | | **2.3** | | | | | | | |
| | 18-Jul-08 | Top | 7.5 | 16.3 | | **126** | | | | | **401** | | | | | | |
| | 14-Aug-08 | Top | 7.6 | 25.0 | | **153** | | | | | **371** | | | | | | |
| | 9-Sep-08 | Top | 7.7 | 30.7 | | **142** | | | | | | | | | | | |
| Reference lake | 3-Jun-06 | Bottom | 6.9 | 14.7 | | **191** | | | | | **402** | | | | | | |
| | 18-Jul-06 | Top | **6.4** | 12.5 | | **173** | | | | | | | | | | | |
| | 17-Aug-06 | Top | 7.4 | 15.9 | | **101** | | | | | **301** | | | | | | |
| | 11-Sep-06 | Top | 7.7 | 20.6 | | **156** | | | | | | | | | | | |
| | 26-May-07 | Top | 6.7 | 86.1 | | | | **1.2** | | **2.5** | **1790** | **125** | | | | | |
| | 21-Jul-07 | Top | 6.8 | 14.0 | | **211** | | | | | **340** | | | | | | |
| | 20-Aug-07 | Top | - | 19.2 | | | | | | **3.1** | | | | | | | |
| Stickleback Lake | 2-Jun-06 | Bottom | 6.9 | 42.2 | | | | | | | | **94.8** | | | | | |
| | 24-May-07 | Top | 7.3 | 202 | | | | | | | **574** | **957** | | | | **2.0** | |
| Doris Lake | 5-Jun-04 | Top | 7.5 | 41.0 | | | **0.066** | | | | | | | | | | |
| | 19-Jul-05 | Top | 7.1 | 41.2 | | | | | | | | | | | | **1.1** | |
| | 19-Jul-05 | Bottom | 7.1 | 40.5 | | **108** | **0.233** | | | **5.66** | | | **1.83** | | **28.3** | **1.1** | |
| | 20-Aug-05 | Top | 7.7 | 41.0 | | | | | | | | | | | | **1.5** | |
| | 20-Aug-05 | Bottom | 7.7 | 40.3 | | | | | | | | | | | | **1.1** | |
| | 31-May-06 | Under ice | 6.5 | 52.6 | | | | | | | | **83.9** | | | | **1.9** | |
| | 31-May-06 | Bottom | 6.5 | 55.0 | | | | | | | | | | | | **2.1** | |
| | 14-Jul-06 | Top | 6.9 | 42.5 | | | | | | | | | | | | **1.1** | |
| | 14-Jul-06 | Bottom | 6.9 | 41.5 | | | | | | | | | | | | **1.1** | |
| | 11-Aug-06 | Top | - | 43.3 | | | | | | | | | | | | **1.2** | |
| | 11-Aug-06 | Bottom | - | 42.3 | | | | | | | | | | | | **1.2** | |
| | 13-Sep-06 | Top | 8.1 | 43.8 | | | | | | | | | | | | **1.5** | |
| | 13-Sep-06 | Bottom | 8.1 | 43.8 | | | | | | | | | | | | **1.2** | |
| | 22-May-07 | Top | 7.8 | 53.1 | | | | | | | | | | | | **1.1** | |
| | 22-May-07 | Bottom | 7.8 | 53.3 | | | | | | **2.2** | | | | | | **1.4** | |
| | 15-Jul-07 | Bottom | 6.7 | 49.6 | | | | | | | | **90.9** | | | | **1.2** | |
| | 16-Aug-07 | Top | 6.9 | 42.9 | | | | | | **2.1** | | | | | | | |
| | 24-May-08 | Top | **6.1** | 56.3 | | **7.1** | | | | | | | | | | | |
| | 24-May-08 | Bottom | **6.1** | 54.6 | | **14.3** | | | | | | | | | | | |
| | 17-Aug-08 | Top | 8.0 | 44.9 | | | | | | | | | | | | **1.2** | |
| | 17-Aug-08 | Bottom | 8.0 | 45.3 | | | | | | | | | | | | **1.1** | |
| | 11-Sep-08 | Top | 8.0 | 46.4 | | | | | | | | | | | | | |
| | 11-Sep-08 | Bottom | 8.0 | 46.0 | | | | | | | | | | | | | |
| Little Roberts Lake | 16-Aug-04 | Top | 7.6 | 41.0 | | **582** | | | | | **462** | | | | | | |
| | 19-Aug-04 | Top | - | - | | **321** | | | | | | | | | | | |
| | 13-Sep-04 | Top | **6.2** | 45.0 | | **134** | | | | | | | | | | | |
| | 19-Aug-05 | Top | 7.6 | 36.8 | | | | | | | | | | | | **1.6** | |
| | 30-May-06 | Top | 7.7 | 29.6 | | **245** | | | | | | | | | | | |
| | 11-Aug-06 | Top | 6.7 | 44.0 | | | | | | | | | | | | **1.1** | |
| | 13-Sep-06 | Top | 7.8 | 49.7 | | | | | | | | | | | | **1.5** | |
| | 24-May-07 | Top | 6.7 | 192 | **613** | **112** | | | **306** | **2.4** | **1700** | **639** | | | | **6.6** | |
| | 18-Aug-07 | Top | 6.9 | 44.0 | | **117** | | | | **2.5** | | | | | | | |
| | 25-May-08 | Top | **6.4** | 108 | | **12** | | | | | **484** | | | | | | |
| | 14-Jul-08 | Top | 7.3 | 39.8 | | **122** | | | | | | | | | | | |
| | 18-Aug-08 | Top | 7.7 | 44.0 | | | | | | | | | | | | **1.1** | |
| | 12-Sep-08 | Top | 7.8 | 44.6 | | | | | | | | | | | | **1.1** | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Roberts Lake | 27-Jul-03 | Top | 7.6 | 33.0 | | | **0.020** | | | | | | | | | | |
| | 17-Jul-04 | Top | - | 33.0 | | **128** | | | | | | | | | | | |
| | 17-Jul-04 | Bottom | - | 34.0 | | **137** | | | | | | | | | | | |
| | 13-Sep-04 | Top | - | 38.0 | | **127** | | | | | | | | **71** | | | |
| | 13-Sep-04 | Bottom | - | 39.0 | | **110** | | | | | | | | | | | |
| | 20-Jul-05 | Top | 7.1 | 32.8 | | **248** | | | | | | | | | | | |
| | 20-Jul-05 | Bottom | 7.1 | 32.8 | | **238** | | | | | | | | | | | |
| | 13-Sep-05 | Top | 7.4 | 39.1 | | **140** | | | | | | | | | | | |
| | 13-Sep-05 | Bottom | 7.5 | 39.8 | | **147** | | | | | | | | | | | |
| | 30-May-06 | Under ice | 7.6 | 43.0 | | | | | | | | | | | | **2.1** | |
| | 14-Jul-06 | Top | 6.7 | 35.5 | | **130** | | | | | | | | | | | |
| | 14-Jul-06 | Bottom | 6.7 | 35.0 | | **137** | | | | | | | | | | | |
| | 10-Aug-06 | Top | 6.8 | 38.0 | | | | | | | | | | | | **1.2** | |
| | 10-Aug-06 | Bottom | 6.8 | 37.1 | | | | | | | | | | | | **1.2** | |
| | 11-Sep-06 | Bottom | 7.8 | 36.9 | | | | | | **3.78** | | | | | | **1.1** | |
| | 24-May-07 | Top | 7.3 | 48.3 | | **153** | | | | | | | | | | **1.2** | |
| | 24-May-07 | Bottom | 7.3 | 51.4 | | **153** | | | | | | | | | | **1.6** | |
| | 15-Jul-07 | Top | **6.1** | 28.5 | | **128** | | | | | | | | | | | |
| | 18-Aug-07 | Top | 6.9 | 37.2 | | **139** | | | | | | | | | | | |
| | 18-Aug-07 | Bottom | 6.9 | 37.0 | | **125** | | | | **2.1** | | | | | | | |
| | 15-Jul-08 | Top | 7.5 | 32.0 | | **162** | | | | | | | | | | | |
| | 15-Jul-08 | Bottom | 7.5 | 32.6 | | **170** | | | | | | | | | | | |
| | 18-Aug-08 | Top | 7.9 | 38.8 | | | | | | **7.3** | | | | | | | |
| | 12-Sep-08 | Top | 7.8 | 40.1 | | **108** | | | | | | | | | | | |
| | 12-Sep-08 | Bottom | 7.8 | 40.4 | | **135** | **0.03** | | | **2.1** | | | | | | | |
| Tail Lake | 5-Jun-04 | Top | - | - | | | | | | | | | **23.6** | | | | |
| | 18-Aug-04 | Top | 7.6 | 32.0 | | **147** | | | | | | | | | | | |
| | 18-Aug-04 | Bottom | 7.6 | 32.0 | | **141** | | | | | | | | | | | |
| | 31-May-06 | Middle | 7.3 | 42.1 | | | | | | | | | | | | **1.9** | |
| | 20-Jul-06 | Top | 7.3 | 31.0 | | | **0.094** | | | | | | | | | | |
| Glenn Lake | 24-May-07 | Top | 7.4 | 87.7 | | | | | | **3.0** | | | | | | **1.7** | |
| | 24-May-07 | Bottom | 7.4 | 87.0 | | | | | | **2.9** | | | | | | **2.0** | |
| | 16-Jul-07 | Top | 7.3 | 57.1 | | **112** | | | | **2.2** | | | | | | **1.1** | |
| | 16-Jul-07 | Bottom | 7.3 | 80.8 | | **125** | | | | **2.8** | | | | | | **1.9** | |
| | 17-Aug-07 | Top | 7.2 | 67.9 | | **457** | | | | **3.1** | **327** | | | | | **1.1** | |
| | 18-Aug-07 | Bottom | 7.2 | 68.9 | | **458** | | | | **2.8** | **325** | | | | | **1.2** | |
| | 15-Sep-07 | Top | - | 71.6 | | **650** | | **1.1** | | **3.8** | **436** | | | | | | |
| | 15-Sep-07 | Bottom | - | 69.7 | | **593** | | | | **3.7** | **391** | | | | | | |
| | 15-Jul-08 | Top | 7.6 | 63.9 | | **250** | | | | **2.7** | | | | | | | |
| | 15-Jul-08 | Bottom | 7.6 | 76.7 | | **219** | | | | **3** | | | | | | | |
| | 18-Aug-08 | Top | 8.2 | 68.3 | | **715** | | **1.24** | | **2.9** | **443** | | | | | **1.4** | |
| | 18-Aug-08 | Bottom | 8.2 | 69.1 | | **831** | | **1.34** | | **3.4** | **571** | | | | | **1.5** | |
| | 13-Sep-08 | Top | 8.5 | 68.6 | | **1010** | | **1.82** | | **3.8** | **821** | | | | | **1.1** | |
| | 13-Sep-08 | Bottom | 8.5 | 68.7 | | **983** | | **1.64** | | **3.5** | **776** | | | | | **1.1** | |
| Ogama Lake | 1-Jun-06 | top | 6.5 | 46.3 | | **495** | | | | **2.2** | **728** | **58.4** | | | | **1.7** | |
| | 1-Jun-06 | bottom | 6.5 | 110 | | **120** | | | | **3** | **823** | **261** | | | | **3.6** | |
| | 21-Jul-06 | top | 7.3 | 39.1 | | **186** | | | | | | | | | | | |
| | 21-Jul-06 | bottom | 7.3 | 38.8 | | **263** | | | | | | | | | | | |
| | 15-Aug-06 | top | 8.3 | 43.2 | | **117** | | | | | | | | | | **1.9** | |
| | 15-Aug-06 | bottom | 8.3 | 43.3 | | **139** | | | | | | | | | | **1.7** | |
| | 8-Sep-06 | top | 8.0 | 45.0 | | **172** | | | | | | | | | | **1.4** | |
| | 8-Sep-06 | bottom | 8.0 | 45.5 | | **184** | | | | | | | | | | **1.4** | |
| | 22-May-07 | Top | 7.1 | 98.7 | | | | | | **2.5** | | **82.4** | | | | **3.1** | |
| | 16-Jul-07 | Top | 7.0 | 42.5 | | **200** | | | | | **319** | **61.6** | | | | | |
| | 16-Aug-07 | Top | 7.1 | 46.3 | | **336** | | | | | | | | | | | |
| | 16-Aug-07 | Bottom | 7.1 | 45.7 | | **375** | | | | **2.2** | **320** | | | | | | |
| | 11-Sep-07 | Top | 7.1 | 46.2 | | **306** | | | | | | | | | | | |
| | 11-Sep-07 | Bottom | 7.1 | 46.1 | | **305** | | | | **2.6** | | | | | | | |
| | 24-May-08 | Top | 6.9 | 121 | | | | | | **2.5** | | | | | | | |
| | 15-Jul-08 | Top | 7.5 | 31.3 | | **200** | | | | | **365** | | | | | | |
| | 15-Jul-08 | Bottom | 7.5 | 30.9 | | **193** | | | | | **352** | | | | | | |
| | 17-Aug-08 | Top | 8.0 | 37.6 | | **230** | | | | | | | | | | **1.1** | |
| | 17-Aug-08 | Bottom | 8.0 | 37.7 | | **217** | | | | | | | | | | | |
| | 10-Sep-08 | Top | 7.9 | 40.2 | | **378** | | | | | **323** | | | | | | |
| | 10-Sep-08 | Bottom | 7.9 | 40.6 | | **403** | | | | | **345** | | | | | | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Patch Lake | 2-Jun-06 | Bottom | 6.8 | 86.6 | | | | | | **2.2** | | | | | | **1.8** | |
| | 23-Jul-06 | Top | 7.0 | 58.5 | | **138** | | | | | | | | | | | |
| | 15-Aug-06 | Top | - | 60.7 | | | | | | | | | | **44** | | **1.6** | |
| | 16-Aug-06 | Bottom | - | 60.4 | | | | | | | | | | | | **1.8** | |
| | 8-Sep-06 | Top | 8.1 | 59.1 | | | | | | | | | | | | **1.3** | |
| | 8-Sep-06 | Bottom | 8.1 | 58.1 | | | | | | | | | | | | **1.8** | |
| | 23-May-07 | Top | 7.4 | 86.2 | | | | | | | | | | | | **1.9** | |
| | 23-May-07 | Bottom | 7.4 | 96.9 | | | | | | | | | | | | **2.1** | |
| | 17-Jul-07 | Top | 7.1 | 74.3 | | | | | | | | | | | | **1.4** | |
| | 17-Jul-07 | Bottom | 7.1 | 92.7 | | | | | | | | | | | | **1.6** | |
| | 15-Aug-07 | Top | 7.0 | 61.4 | | **306** | | | | **2.2** | | | | | | **1.2** | |
| | 15-Aug-07 | Bottom | 7.0 | 60.7 | | **351** | | | | **3.8** | | | | | | **1.3** | |
| | 11-Sep-07 | Top | - | 59.5 | | **195** | | | | | | | | | | | |
| | 11-Sep-07 | Bottom | - | 59.3 | | **179** | | | | | | | | | | | |
| | 17-Jul-08 | Top | 7.7 | 46.6 | | **194** | | | | | | | | | | | |
| | 17-Jul-08 | Bottom | 7.7 | 52.2 | | **104** | | | | | | | | | | | |
| | 15-Aug-08 | Top | 8.0 | 62.8 | | | | | | | | | | | | **1.3** | |
| | 15-Aug-08 | Bottom | 8.0 | 62.8 | | **101** | | | | | | | | | | **1.5** | |
| | 10-Sep-08 | Top | 7.9 | 64.7 | | **273** | | | | | | | | | | **1.1** | |
| | 10-Sep-08 | Bottom | 7.9 | 65.6 | | **240** | | | | | | | | | | **1.3** | |
| Pelvic Lake | 1-Jun-06 | Top | 6.5 | 43.3 | | | | | | **2.7** | | | | | | **1.5** | |
| | 1-Jun-06 | Bottom | 6.5 | 51.9 | | | | | | | **407** | **346** | | | | **2.0** | |
| | 21-Jul-06 | Top | **8.6** | 32.8 | | | | | | | | | | | | | |
| | 21-Jul-06 | Bottom | **8.6** | 32.2 | | | | | | **2.4** | | | | | | | |
| | 16-Aug-06 | Top | 8.2 | 34.4 | | | | | | | | | | | | **1.5** | |
| | 16-Aug-06 | Bottom | 8.2 | 34.1 | | | | | | | | | | | | **1.5** | |
| | 9-Sep-06 | Top | 8.2 | 35.7 | | **103** | | | | | | | | | | **1.9** | |
| | 9-Sep-06 | Bottom | 6.8 | 34.1 | | **133** | | | | **2.3** | | | | | | **1.6** | |
| | 23-May-07 | Top | 7.7 | 47.7 | | | | | | | | | | | | **2.1** | |
| | 23-May-07 | Bottom | 7.7 | 52.1 | | | | | | | **1100** | **1160** | | | | **2.0** | |
| | 16-Jul-07 | Top | 6.9 | 31.5 | | **186** | | | | | | | | | | **1.1** | |
| | 16-Jul-07 | Bottom | 6.9 | 42.1 | | **111** | | | | | **2760** | **642** | | | | **1.1** | |
| | 16-Aug-07 | Top | 6.7 | 34.4 | | **201** | | | | | | | | | | | |
| | 16-Aug-07 | Bottom | 6.7 | 36.0 | | **178** | | | | **3.0** | **429** | **120** | | | | | |
| | 13-Sep-07 | Top | - | 35.0 | | **258** | | | | | | | | | | | |
| | 13-Sep-07 | Bottom | - | 35.2 | | **262** | | | | | | | | | | | |
| | 15-Jul-08 | Top | 7.3 | 30.4 | | **191** | | | | | | | | | | | |
| | 15-Jul-08 | Bottom | 7.3 | 44.7 | | **139** | | | | | **1950** | **268** | | | | | |
| | 17-Aug-08 | Top | 8.0 | 33.1 | | **141** | | | | | **329** | | | | | | |
| | 17-Aug-08 | Bottom | 8.0 | 33.6 | | **145** | | | | | **327** | | | | | | |
| | 11-Sep-08 | Top | 7.6 | 34.4 | | **239** | | | | | | | | | | | |
| | 11-Sep-08 | Bottom | 7.6 | 35.1 | | **246** | | | | | | | | | | | |
| P.O. Lake | 23-Jul-06 | Top | 7.4 | 51.2 | | **106** | | | | | | | | | | | |
| | 15-Aug-06 | Top | 8.3 | 55.9 | | **115** | | | | | | | | | | **1.5** | |
| | 8-Sep-06 | Top | 8.3 | 56.3 | | **176** | | | | | | | | | | **2.2** | |
| | 17-Jul-07 | Top | 7.4 | 51.9 | | **121** | | | | | | | | | | **1.3** | |
| | 15-Aug-07 | Top | 7.0 | 57.4 | | **369** | | | | | | | | | | **1.3** | |
| | 11-Sep-07 | Top | 7.1 | 55.0 | | **527** | | | | | **314** | | | | | **1.2** | |
| | 14-Jul-08 | Top | 7.7 | 38.2 | | **158** | | | | | | | | | | | |
| | 17-Aug-08 | Top | 7.8 | 49.3 | | **394** | | | | | | | | | | **1.2** | |
| | 10-Sep-08 | Top | 7.9 | 53.4 | | **923** | | **1.54** | | | **581** | | | | | **1.3** | |
| Windy Lake | 2-Jun-06 | Top | 6.7 | 76.0 | | | | | | | | | | | | **1.7** | |
| | 2-Jun-06 | Bottom | 6.7 | 77.4 | | | | | | | | | | | | **1.6** | |
| | 24-Jul-06 | Top | 6.9 | 69.2 | | | | | | | | | | | | **1.1** | |
| | 24-Jul-06 | Bottom | 6.9 | 67.9 | | | | | | | | | | | | **1.3** | |
| | 18-Aug-06 | Top | 8.2 | 68.7 | | | | | | | | | | | | **1.5** | |
| | 18-Aug-06 | Bottom | 8.2 | 68.6 | | | | | | | | | | | | **1.7** | |
| | 9-Sep-06 | Top | 8.1 | 70.0 | | | | | | | | | | | | **2.1** | |
| | 9-Sep-06 | Bottom | 8.1 | 69.4 | | | | | | | | | | | | **2.3** | |
| | 24-May-07 | Top | 7.5 | 80.7 | | | | | | | | | | | | **2.2** | |
| | 24-May-07 | Bottom | 7.5 | 80.7 | | | | | | | | | | | | **2.3** | |
| | 18-Jul-07 | Bottom | 7.3 | 78.7 | | | | | | | | | | | | **1.6** | |
| | 20-Aug-07 | Top | **6.4** | 67.2 | | **89.7** | | | | | | | | | | **1.1** | |
| | 20-Aug-07 | Bottom | **6.4** | 65.3 | | **93.3** | | | | | | | | | | | |
| | 15-Sep-07 | Top | - | 70.0 | | **110** | | | | | | | | | | | |
| | 15-Sep-07 | Bottom | - | 70.4 | | **146** | | | | | | | | | | | |
| | 19-Aug-08 | Top | 8.4 | 65.5 | | | | | | | | | | | | **2** | |
| | 19-Aug-08 | Bottom | 8.4 | 66.0 | | **107** | | | | | | | | | | **2.3** | |
| | 14-Sep-08 | Top | 8.1 | 72.9 | | | | | | | | | | | | **1.2** | |
| | 14-Sep-08 | Bottom | 8.1 | 72.7 | | | | | | | | | | | | **1.3** | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Wolverine lake | 1-Jun-06 | Bottom | 6.6 | 35.8 | | | **0.016** | | | | | | | | | | |
| | 22-Jul-06 | Top | 8.1 | 55.4 | | | | | | | | | | | | **1.1** | |
| | 22-Jul-06 | Bottom | 8.1 | 55.9 | | | | | | | | | | | | **1.3** | |
| | 12-Aug-06 | Top | 7.7 | 57.1 | | | | | | | | | | | | **1.5** | |
| | 8-Sep-06 | Top | 8.3 | 58.1 | | | | | | | | | | | | **1.4** | |
| | 23-May-07 | Top | 7.3 | 148 | | | | | | | | | | | | **4.4** | |
| | 17-Jul-07 | Top | 7.8 | 53.2 | | | | | | | | | | | | **1.3** | |
| | 15-Aug-07 | Top | 6.8 | 58.5 | | **168** | | | | | | | | | | **1.1** | |
| | 23-May-08 | Top | 6.7 | 181 | **560** | **205** | | | **275** | | **729** | **565** | | | | | |
| | 14-Jul-08 | Top | 7.8 | 48.9 | | | | | | | | | | | | | |
| | 15-Aug-08 | Top | 8.3 | 57.8 | | | | | | | | | | | | **1.5** | |
| Aimaokatalok Inflow | 23-Jun-06 | | 7.4 | 14.0 | | **176** | | | | | **450** | | | | | | |
| | 16-Jul-06 | | 7.2 | 16.1 | | **135** | **0.010** | | | | **417** | | | | | | |
| | 13-Aug-06 | | 7.2 | 18.8 | | | | | | | **544** | | | | | | |
| | 10-Sep-06 | | 7.1 | 26.1 | | **120** | | | | | **573** | | | | | | |
| | 23-Jun-07 | | - | 13.1 | | **728** | **0.007** | **1.4** | | | **1020** | **63.9** | | | | | |
| | 20-Jul-07 | | 6.6 | 19.5 | | | | | | | **521** | | | | | | |
| | 20-Aug-07 | | 6.5 | 21.6 | | **206** | | | | | **393** | | | | | | |
| | 10-Sep-07 | | **6.1** | 24.2 | | **144** | | | | | **329** | | | | | | |
| | 24-Jun-08 | | 6.6 | 11.0 | | **836** | | **1.3** | | | **887** | | | | | | |
| | 19-Jul-08 | | 7.3 | 16.4 | | **123** | **0.026** | | | | **517** | | | | | | |
| | 13-Aug-08 | | 7.2 | 19.6 | | **196** | | | | | **643** | | | | | | |
| | 8-Sep-08 | | 8.4 | 21.2 | | **302** | | | | | **425** | | | | | | |
| Aimaokatalok Outflow | 23-Jun-06 | | - | 12.7 | | | **0.008** | | | | | | | | | | |
| | 23-Jun-07 | | **6.1** | 13.7 | | **27.3** | | | | | | | | | | | |
| | 20-Jul-07 | | **6.2** | 12.4 | | **30.5** | **0.009** | | | | | | | | | | |
| | 19-Aug-07 | | **6.2** | 12.4 | | **42.7** | | | | | | | | | | | |
| | 10-Sep-07 | | **6.0** | 13.1 | | **59.8** | | | | | | | | | | | |
| | 24-Jun-08 | | 6.6 | 12.9 | | **122** | | | | | | | | | | | |
| Aimaokatalok River | 23-Jun-06 | | - | 6.8 | | | **0.004** | | | | | | | | | | |
| | 13-Aug-06 | | 6.9 | 10.0 | | | | | | | | | | | | | **26.1** |
| | 23-Jun-07 | | **6.0** | 10.3 | | **153** | | | | | **375** | | | | | | |
| | 21-Jul-07 | | **6.3** | 15.3 | | **16.3** | | | | | | | | | | | |
| | 9-Sep-07 | | **6.3** | 12.9 | | **20.3** | | | | | | | | | | | |
| | 24-Jun-08 | | 6.7 | 7.3 | | **155** | | | | | | | | | | | |
| | 15-Aug-08 | | 7.5 | 7.97 | | | | | | | **350** | | | | | | |
| | 15-Sep-08 | | 7.3 | 11.1 | | | | | | **3.7** | | | | | | | |
| Fickle Duck Outflow | 24-Jun-06 | | 7.1 | 15.3 | | **275** | | | | | **605** | | | | | | |
| | 17-Jul-06 | | 6.5 | 26.7 | | **666** | **0.011** | **1.2** | | | **2760** | | | | | | |
| | 13-Aug-06 | | **6.3** | 22.7 | | **407** | | | | | **1630** | | | | | | |
| | 10-Sep-06 | | 6.7 | 25.7 | | **158** | | | | | **671** | | | **55** | | | |
| | 23-Jun-07 | | **6.2** | 16.6 | | **80.4** | | | | | | | | | | | |
| | 20-Jul-07 | | **6.0** | 32.8 | | **274** | | | | | **3460** | **139** | | | | | |
| | 20-Aug-07 | | 6.5 | 26.3 | | **125** | | | | | **312** | | | | | | |
| | 26-Jun-08 | | **6.4** | 14.5 | | **327** | | | | | **509** | | | | | | |
| | 18-Jul-08 | | 6.9 | 16.8 | | | | | | | **505** | | | | | | |
| | 14-Aug-08 | | 7.3 | 25.8 | | **108** | | | | | **366** | | | | | | |
| | 15-Sep-08 | | 7.3 | 30.7 | | **328** | | | | **2.3** | **540** | | | | | | |
| Koignuk River | 2-Jul-07 | | 6.5 | 13.1 | | **317** | | | | | **313** | | | | | | |
| | 19-Jul-07 | | 6.6 | 14.3 | | **112** | | | | | | | | | | | |
| | 18-Aug-07 | | 6.8 | 21.6 | | **650** | **0.024** | | | | **523** | | | | | | |
| | 16-Sep-07 | | 6.9 | 20.5 | | **403** | | | | | **366** | | | | | | |
| | 23-Jun-08 | | 7.1 | 15.9 | | **1360** | | **2.2** | | | **1160** | | | | | | |
| | 17-Jul-08 | | 7.3 | 12.7 | | **238** | | | | | | | | | | | |
| | 19-Aug-08 | | 7.8 | 16.2 | | **297** | | | | | | | | | | | |
| | 14-Sep-08 | | 8.0 | 17.5 | | **353** | **0.165** | **3.1** | | | **315** | | | | | | |
| Reference Outflow | 23-Jun-06 | | 7.5 | 11.1 | | **178** | | | | | | | | | | | |
| | 18-Jul-06 | | 6.6 | 15.3 | | | | | | | **324** | | | | | | |
| | 13-Aug-06 | | 7.8 | 13.3 | | **154** | | | | | **369** | | | | | | |
| | 10-Sep-06 | | 7.2 | 20.2 | | **118** | | | | | | | | | | | |
| | 23-Jun-07 | | **6.1** | 15.1 | | **173** | | | | | **356** | | | | | | |
| | 20-Jul-07 | | 6.7 | 14.1 | | **160** | | | | | **506** | | | | | | |
| | 9-Sep-07 | | **6.4** | 18.9 | | **54.2** | | | | | | | | | | | |
| | 24-Jun-08 | | 6.7 | 9.07 | | **290** | | | | | **350** | | | | | | |
| | 18-Jul-08 | | 7.0 | 11.4 | | | | | | | **366** | | | | | | |
| Stickleback outflow | 17-Jul-06 | | 6.9 | 69.6 | | **116** | | | | | **602** | **82.8** | | | | | |
| | 13-Aug-06 | | - | 72.3 | | | | | | | | **60.6** | | | | | |
| | 10-Sep-06 | | **6.3** | 75.8 | | **13.6** | | | | | **1030** | **166** | | | | | |
| | 23-Jun-07 | | **6.0** | 9.7 | | **30.2** | | | | | | **152** | | | | | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Doris Outflow | 27-Jun-05 | | 6.9 | 35.3 | | **145** | | | | | | | | | | | |
| | 5-Aug-05 | | 7.0 | 42.7 | | | **0.002** | | | | | | | | | | |
| | 20-Aug-05 | | 7.6 | 44.2 | | **774** | **0.005** | **1.4** | | **2.1** | **888** | | | | | | |
| | 1-Sep-05 | | 7.6 | 40.9 | | | | **1.3** | | | | | | | | **1.1** | |
| | 18-Jun-06 | | 7.4 | 36.4 | | **106** | | | | | | | | | | | |
| | 30-Jun-06 | | 7.6 | 38.5 | | | | | | | | | | | | | |
| | 7-Jul-06 | | 7.3 | 38.8 | | | | | | | | | | | | **1.4** | |
| | 13-Jul-06 | | 6.5 | 41.3 | | | | | | | | | | | | **1.2** | |
| | 28-Jul-06 | | **6.2** | 44.2 | | **59.9** | | | | | | | | | | | |
| | 4-Aug-06 | | 7.4 | 43.2 | | | | | | | | | | | | **1.3** | |
| | 11-Aug-06 | | **6.2** | 44.7 | | **41.9** | | | | | | | | | | **1.1** | |
| | 18-Aug-06 | | 7.9 | 47.5 | | | | | | | | | | | | **1.6** | |
| | 26-Aug-06 | | 7.9 | 44.6 | | | | | | | | | | | | **1.7** | |
| | 1-Sep-06 | | 8.0 | 45.9 | | **146** | | | | | **356** | **64.2** | | | | **1.6** | |
| | 9-Sep-06 | | 7.7 | 48.2 | | | | | | | | | | | | **1.4** | |
| | 9-Sep-06 | | 7.6 | 46.0 | | | | | | | | | | | | **1.6** | |
| | 20-Jun-07 | | 7.1 | 55.1 | | | | | | **3.3** | | | | | | | |
| | 7-Jul-07 | | **6.1** | 34.5 | | **78.5** | | | | | | | | | | | |
| | 14-Jul-07 | | 6.8 | 50.0 | | | | | | | | | | | | **1.2** | |
| | 27-Jul-07 | | **5.7** | 45.6 | | **50.3** | | | | | | | | | | **1.3** | |
| | 12-Aug-07 | | **6.2** | 45.1 | | **67.0** | | | | | | | | | | | |
| | 31-Aug-07 | | - | 42.2 | | **159** | | | | | | | | | | | |
| | 22-Jun-08 | | 7.0 | 41.8 | | **414** | | | | **2.1** | **664** | | | | | | |
| | 14-Aug-08 | | 8.0 | 45.1 | | | | | | | | | | | | **1.1** | |
| | 12-Sep-08 | | 7.5 | 46.2 | | | | | | | | | | | | | |
| Little Roberts Outflow | 20-Jun-04 | | - | 43.0 | | **243** | | | | | | | | | | | |
| | 16-Jul-04 | | - | 38.0 | | **114** | | | | | | | | | | | |
| | 19-Aug-04 | | - | - | | **191** | | | | | | | | | | | |
| | 12-Sep-04 | | - | 44.0 | | **140** | | | | | | | | | | | |
| | 22-Sep-04 | | - | 43.0 | | **151** | | | | | | | | | | | |
| | 28-Jun-05 | | 7.0 | 36.2 | | **498** | | | | | **656** | | | | | | |
| | 19-Aug-05 | | 7.5 | 40.2 | | | | | | | | | | | | **1.34** | |
| | 31-Aug-05 | | 7.4 | 41.8 | | **156** | | **1.4** | | | | | | | | | |
| | 14-Sep-05 | | 7.5 | 34.9 | | | | | | | | | | | | **1.35** | |
| | 18-Jun-06 | | 7.6 | 30.9 | | **379** | | **1.1** | | | **318** | | | | | | |
| | 13-Jul-06 | | 6.7 | 38.9 | | | | | | | | | | | | **1** | |
| | 10-Aug-06 | | 7.4 | 42.9 | | | | | | | | | | | | **1.3** | |
| | 9-Sep-06 | | 7.6 | 49.2 | | | | | | | | | | | | **1.9** | |
| | 20-Jun-07 | | 6.8 | 37.2 | | **155** | | | | | | **74.4** | | | | **1.2** | |
| | 14-Jul-07 | | 6.8 | 35.9 | | | **0.034** | | | | | | | | | | |
| | 12-Aug-07 | | 6.9 | 47.2 | | **179** | | | | | | | | | | | |
| | 19-Jun-08 | | 6.8 | 41.5 | | **563** | | | | | **672** | | | | | | |
| | 17-Jul-08 | | 7.7 | 43.3 | | **119** | | | | | | | | | | | |
| | 14-Aug-08 | | 7.8 | 44.4 | | | | | | | | | | | | **1.1** | |
| | 12-Sep-08 | | 7.8 | 43.0 | | | | | | | | | | | | **1.1** | |
| Roberts Outflow | 20-Jun-04 | | - | 35.0 | | **147** | | | | | | | | | | | |
| | 17-Jul-04 | | - | 33.0 | | **153** | | | | | | | | | | | |
| | 19-Aug-04 | | - | - | | **315** | | | | | | | | | | | |
| | 12-Sep-04 | | - | 38.0 | | **108** | | | | | | | | | | | |
| | 22-Sep-04 | | - | 36.0 | | **141** | | | | | | | | | | | |
| | 28-Jun-05 | | 6.9 | 29.0 | | **813** | | **1.3** | | | **656** | | | | | | |
| | 17-Jul-05 | | 7.1 | 34.9 | | **102** | | | | | | | | | | | |
| | 5-Aug-05 | | 7.0 | 35.7 | | **104** | | | | | | | | | | | |
| | 31-Aug-05 | | 7.4 | 35.1 | | **169** | | **1.3** | | | | | | | | | |
| | 13-Sep-05 | | 7.4 | 40.8 | | **126** | | | | | | | | | | | |
| | 18-Jun-06 | | 7.5 | 28.6 | | **383** | | **1.1** | | | **313** | | | | | | |
| | 13-Jul-06 | | 7.4 | 35.2 | | **228** | | | | | | | | | | **1.1** | |
| | 10-Aug-06 | | 7.1 | 36.9 | | | | | | | | | | | | **1.2** | |
| | 9-Sep-06 | | 7.9 | 36.2 | | | | | | | | | | | | **1.2** | |
| | 20-Jun-07 | | 7.0 | 33.6 | | **241** | | | | | | | | | | **1.4** | |
| | 12-Aug-07 | | 6.7 | 37.7 | | **241** | **0.027** | | | **2.4** | | | | | | | |
| | 16-Sep-07 | | 7.0 | 41.1 | | **104** | | | | | | | | | | | |
| | 19-Jun-08 | | 6.8 | 30.9 | | **668** | | **1.1** | | | **663** | | | | | | |
| | 17-Jul-08 | | **8.6** | 32.9 | | **133** | | | | | | | | | | | |
| | 12-Sep-08 | | 8.1 | 40.7 | | **117** | | | | | | | | | | | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Tail Outflow | 21-Aug-05 | | 7.2 | 37.0 | | | | | | | 732 | | | | | | |
| | 20-Jul-06 | | 7.3 | 35.2 | | | | | | | 358 | | | | | | |
| | 28-Jul-06 | | 6.0 | 39.6 | | 12.1 | | | | | | | | | | | |
| | 4-Aug-06 | | 6.3 | 44.0 | | 16.8 | | | | | 301 | | | | | | |
| | 11-Aug-06 | | 6.0 | 59.2 | | 16.9 | | | | | 507 | | | | | 1.2 | |
| | 18-Aug-06 | | 7.0 | 73.3 | | | | | | | 634 | | | | | 1.5 | |
| | 26-Aug-06 | | 6.9 | 79.7 | | | | | | | 853 | | | | | 2.0 | |
| | 1-Sep-06 | | 6.9 | 92.2 | | | | | | | 1150 | | | | | 2.2 | |
| | 9-Sep-06 | | 6.9 | 74.6 | | | | | | | 1070 | | | | | 1.9 | |
| | 7-Jul-07 | | 5.8 | 36.0 | | 30.2 | 0.016 | | | | | | | | | | |
| | 27-Jul-07 | | 6.2 | 36.7 | | 15.1 | | | | | | | | | | | |
| | 12-Aug-07 | | 6.2 | 38.9 | | 10.2 | | | | | | | | | | | |
| | 18-Aug-07 | | 6.4 | 37.8 | | 23.4 | | | | | | | | | | | |
| | 25-Aug-07 | | 6.3 | 34.2 | | 15.8 | | | | | | | | | | | |
| | 9-Sep-07 | | 6.1 | 36.1 | | 21.9 | | | | | | | | | | | |
| | 14-Aug-08 | | 7.1 | 38.1 | | | | | | | 935 | | | | | | |
| Glenn Outflow | 22-Jun-07 | | 6.9 | 56.1 | | 195 | | | | 2.6 | | | | | | 1.5 | |
| | 19-Jul-07 | | 7.5 | 55.3 | | 611 | | 1.2 | | 2.4 | 550 | | | | | 1.4 | |
| | 12-Aug-07 | | 7.1 | 68.9 | | 570 | | | | 2.9 | 357 | | | | | 1.3 | |
| | 15-Sep-07 | | - | 75.9 | | 694 | | 1.2 | | 4.1 | 457 | | | | | | |
| | 19-Jun-08 | | 6.8 | 47.3 | | 267 | | | | 2.4 | | | | | | | |
| | 17-Jul-08 | | 7.8 | 61.0 | | 700 | | 1.16 | | 2.9 | 535 | | | | | | |
| | 19-Aug-08 | | 8.1 | 70.9 | | 605 | | | | 3.1 | 427 | | | | | 1.7 | |
| | 13-Sep-08 | | 8.3 | 69.2 | | 858 | | 1.5 | | 3.5 | 675 | | | | | 1.1 | |
| Ogama Outflow | 19-Jun-06 | | 6.6 | 37.8 | | 290 | | | | | 323 | | | | | | |
| | 21-Jul-06 | | 7.7 | 40.7 | | 181 | | | | | | | | | | | |
| | 12-Aug-06 | | 7.5 | 42.9 | | | | | | | | | | | | 1.3 | |
| | 9-Sep-06 | | 7.5 | 45.2 | | 119 | | | | | | | | | | 2.0 | |
| | 22-Jun-07 | | 6.9 | 45.3 | | 150 | | | | | | 90.8 | | | | 1.6 | |
| | 17-Jul-07 | | 7.3 | 42.1 | | 198 | | | | | 368 | 62.5 | | | | 1.1 | |
| | 12-Aug-07 | | 6.9 | 45.7 | | 258 | | | | | | | | | | | |
| | 17-Sep-07 | | 6.8 | 46.8 | | 221 | | | | | | | | | | | |
| | 23-Jun-08 | | 6.8 | 35.0 | | 385 | | | | | 641 | | | | | | |
| | 17-Jul-08 | | 7.5 | 33.5 | | 240 | | | | | 437 | 62.5 | | | | | |
| | 19-Aug-08 | | 8.0 | 35.7 | | 203 | | | | | | | | | | 1.1 | |
| | 14-Sep-08 | | 8.3 | 40.4 | | 338 | | | | | 333 | | | | | | |
| Patch outflow | 19-Jun-06 | | 6.6 | 29.4 | | 135 | | | | | | | | | | | |
| | 22-Jul-06 | | 7.7 | 59.7 | | 253 | | | | | | | | | | 1.4 | |
| | 12-Aug-06 | | 6.8 | 60.2 | | 441 | | | | | 376 | | | | | 1.5 | |
| | 9-Sep-06 | | 7.6 | 62.0 | | | | | | | | | | | | 1.2 | |
| | 22-Jun-07 | | 5.6 | 12.1 | | 320 | | | | 3.0 | 497 | 141.0 | | | | | |
| | 12-Aug-07 | | 6.8 | 59.3 | | 763 | | 1.2 | | | 491 | | | | | 1.3 | |
| | 17-Sep-07 | | 6.9 | 64.7 | | 214 | | | | | | | | | | | |
| | 17-Jul-08 | | 7.6 | 55.3 | | 199 | | | | | | | | | | | |
| | 19-Aug-08 | | 8.2 | 62.8 | | 144 | | | | | | | | | | 1.6 | |
| | 10-Sep-08 | | 8.0 | 68.6 | | 159 | | | | | | | | | | 1.1 | |
| Pelvic Outflow | 19-Jun-06 | | 6.6 | 30.4 | | 119 | | | | | | 55.1 | | | | | |
| | 21-Jul-06 | | 8.8 | 33.1 | | 135 | | | | | | | | | | | |
| | 16-Aug-06 | | 7.9 | 35.2 | | 143 | | | | | | | | | | 1.6 | |
| | 22-Jun-07 | | 6.5 | 15.1 | | | | | | | | | | | | 1.3 | |
| | 19-Jul-07 | | 7.5 | 14.1 | | 128 | | | | | | | | | | 1.1 | |
| | 18-Aug-07 | | 7.0 | 17.5 | | 380 | | | | | 421 | | | | | | |
| | 16-Sep-07 | | 6.7 | 18.9 | | 220 | | | | | | | | | | | |
| | 21-Jun-08 | | 7.1 | 18.4 | | 195 | | | | | 321 | | | | | | |
| | 17-Jul-08 | | 7.4 | 30.6 | | 186 | | | | | 504 | | | | | | |
| | 19-Aug-08 | | 8.7 | 31.1 | | 236 | | | | | | | | | | 1.1 | |
| | 11-Sep-08 | | 7.8 | 33.6 | | 394 | | | | | 362 | 54.9 | | | | | |
| P.O. Outflow | 19-Jun-06 | | 6.6 | 24.3 | | 192 | | | | | | | | | | | |
| | 24-Jul-06 | | 7.1 | 50.6 | | 115 | | | | | | | | | | | |
| | 15-Aug-06 | | 8.2 | 54.1 | | | | | | | | | | | | 2.0 | |
| | 9-Sep-06 | | 7.7 | 59.7 | | 113 | | | | | | | | | | 1.8 | |
| | 22-Jun-07 | | 5.6 | 23.4 | | 275 | | | | | 346 | 92.9 | | | | | |
| | 19-Jul-07 | | 7.3 | 53.1 | | 106 | | | | | | | | | | 1.1 | |
| | 12-Aug-07 | | 7.2 | 56.3 | | 318 | | | | | 479 | | | | | 1.2 | |
| | 17-Sep-07 | | 6.8 | 52.3 | | 321 | | | | | | | | | | | |
| | 21-Jun-08 | | 7.4 | 52.6 | | 226 | | | | | | | | | | | |
| | 17-Jul-08 | | 7.6 | 37.2 | | 564 | | 1.09 | | | 483 | | | | | | |
| | 19-Aug-08 | | 8.1 | 48.3 | | 299 | | | | | | | | | | 1.4 | |
| | 10-Sep-08 | | 7.9 | 53.6 | | 718 | | 1.13 | | | 440 | | | | | 1.3 | |

**Appendix B6. Freshwater Exceedences of Water Quality and Drinking Water Guidelines, 2003 - 2008**

| Site | Date | Strata | Field pH | Total Hardness (mg $CaCO_3$/L) | TDS (mg/L) | Total Aluminum (µg/L) | Total Cadmium (µg/L) | Total Chromium (µg/L) | Chloride (µg/L) | Total Copper (µg/L) | Total Iron (µg/L) | Total Manganese (µg/L) | Total Lead (µg/L) | Trace Mercury (ng/L) | Total Nickel (µg/L) | Total Selenium (µg/L) | Total Zinc (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | CWQG[a] 6.5 - 9.0 | - | - | CWQG 5 or 100 µg/L | CWQG 0.003-0.055 µg/L | CWQG 1 µg/L or USEPA 16 ug/L | - | CWQG 2-4 µg/L | CWQG 300 µg/L | - | CWQG 1-7 µg/L | CWQG 26 ng/L | CWQG 25-150 µg/L | CWQG 1 µg/L | CWQG 30 µg/L or USEPA 13-198 µg/L |
| | | | CDWG[a] 6.5 - 8.5 | - | CDWG <500 mg/L | - | CDWG 5 µg/L | CDWG 50 µg/L | CDWG <250 ug/L | CDWG <1000 µg/L | CDWG <300 µg/L | CDWG <50 µg/L | CDWG 10 µg/L | CDWG 1000 ng/L | - | CDWG 10 µg/L | CDWG <5000 µg/L |
| Windy Outflow | 19-Jun-06 | | 7.0 | 69.1 | | | | | | | | | | | | **1.5** | |
| | 23-Jul-06 | | 7.5 | 68.7 | | | | | | | | | | | | **1.2** | |
| | 12-Aug-06 | | 7.5 | 67.7 | | | | | | | | | | | | **1.8** | |
| | 16-Aug-06 | | - | 35.3 | | **204** | | | | | | | | | | **1.7** | |
| | 9-Sep-06 | | 6.9 | 68.2 | | | | | | | | | | | | **2.0** | |
| | 22-Jun-07 | | 7.2 | 24.9 | | | | | | **2.2** | | | | | | | |
| | 19-Jul-07 | | 6.9 | 54.4 | | | | | | | | | | | | **1.3** | |
| | 22-Jun-08 | | 7.5 | 39.3 | | **159** | | | | | | | | | | | |
| | 17-Jul-08 | | 7.5 | 53.8 | | **112** | | | | | | | | | | | |
| | 19-Aug-08 | | 8.0 | 71.3 | | | | | | | | | | | | **2.2** | |
| | 14-Sep-08 | | 8.0 | 73.0 | | | **0.036** | | | | | | | | | **1.3** | |

**Notes:**

True Colour Canadian Drinking Water Aesthetic Objective exceedences were not included due to most samples exceeding these values

[a] All guidelines are explained in Appendix B1.

**Exceedances - Aquatic Life**

**Exceedances - Drinking Water**

**Exceedances - Aquatic Life and Drinking Water**

# APPENDIX B7

# ANALYTICAL RESULTS FOR MARINE WATER QUALITY SAMPLES

Appendix B7. Analytical results for marine water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | Hope Bay Top | | | Hope Bay Bottom | | |
|---|---|---|---|---|---|---|---|---|
| | | | 16-Jul-08 | 19-Aug-08 | 13-Sep-08 | 16-Jul-08 | 19-Aug-08 | 13-Sep-08 |
| **Physical** | | | | | | | | |
| Alkalinity (Total as CaCO3) | mg/L | | 11 | 28 | 68 | 95 | 80 | 76 |
| Specific Conductivity (lab) | µS/cm | | 4000 | 27000 | 27000 | 41000 | 30000 | 30000 |
| Total Dissolved Solids | mg/L | | 2200 | 15000 | 15000 | 27000 | 19000 | 19000 |
| Total Suspended Solids | mg/L | | <4 | 11 | 11 | 11 | 11 | 11 |
| Hardness (Total as CaCO3) | mg/L | | 264 | 3640 | 3640 | 4950 | 3160 | 3160 |
| Hardness (Dissolved as CaCO3) | mg/L | | 283 | 3810 | 3810 | 5080 | 3200 | 3200 |
| Field pH | pH Unit | 7.0 - 8.7 | 7.6 | 7.9 | 8.1 | 7.6 | 7.9 | 8.1 |
| **Nutrients** | | | | | | | | |
| Total Phosphorus | mg/L | | 0.006 | <0.05 | 0.061 | 0.029 | <0.05 | <0.05 |
| Total Kjeldahl Nitrogen | mg/L | | 0.14 | 0.13 | 0.13 | 0.13 | 0.1 | 0.1 |
| Total Nitrogen | mg/L | | 0.14 | 0.13 | 0.13 | 0.13 | 0.1 | 0.1 |
| Ammonia - N | mg/L | | 0.008 | 0.017 | 0.017 | 0.041 | 0.02 | 0.02 |
| Nitrite+Nitrate as N | mg/L | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Nitrite as N | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrate | mg/L | 3.6 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| **Organics** | | | | | | | | |
| Organic Carbon (dissolved) | mg/L | | 2.9 | 2.4 | 2.4 | 0.8 | 2.2 | 2.2 |
| Organic Carbon (total) | mg/L | | 3.3 | 2.6 | 2.6 | 1.2 | 3 | 3 |
| Chlorophyll a | µg/L | | 0.41 | 0.3 | 0.44 | | | |
| **Major Ions** | | | | | | | | |
| Bicarbonate | mg/L | | 14 | 83 | 83 | 120 | 92 | 92 |
| Carbonate | mg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Calcium (total) | mg/L | | 20.1 | 270 | 269 | 366 | 235 | 235 |
| Calcium (dissolved) | mg/L | | 21.7 | 285 | 267 | 377 | 241 | 241 |
| Chloride | mg/L | | 1100 | 9100 | 9100 | 14000 | 9900 | 9900 |
| Magnesium (total) | mg/L | | 52 | 721 | 729 | 980 | 625 | 625 |
| Magnesium (dissolved) | mg/L | | 55.5 | 752 | 703 | 1010 | 632 | 632 |
| Potassium (total) | µg/L | | 16.7 | 221 | 220 | 328 | 192 | 192 |
| Potassium (dissolved) | µg/L | | 18 | 220 | 233 | 348 | 193 | 193 |
| Sodium (total) | µg/L | | 419 | 6110 | 6190 | 8620 | 5350 | 5350 |
| Sodium (dissolved) | µg/L | | 461 | 6380 | 5980 | 8910 | 5340 | 5340 |
| Sulfate | mg/L | | 160 | | | 2000 | | |
| **Total Metals** | | | | | | | | |
| Aluminum | µg/L | | 98 | 20 | 19 | 22 | 26 | 26 |
| Antimony | µg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Arsenic | µg/L | 12.5 | 1.2 | 1.2 | 1.3 | 2.6 | 1.1 | 1.1 |
| Barium | µg/L | | 3 | 7 | 7 | 11 | 6 | 6 |
| Beryllium | µg/L | | <0.1 | <1 | <1 | <0.1 | <1 | <1 |
| Bismuth | µg/L | | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron | µg/L | | 206 | 2200 | 2160 | 2930 | 1950 | 1950 |
| Cadmium | µg/L | 0.12 | 0.02 | <0.05 | 0.06 | ***0.15*** | <0.05 | <0.05 |
| Chromium | µg/L | | <1 | 0.9 | 0.8 | <1 | 0.7 | 0.7 |
| Cobalt | µg/L | | <0.5 | <0.1 | <0.1 | <0.5 | <0.1 | <0.1 |
| Copper | µg/L | | 1.1 | 0.8 | 0.9 | 0.8 | 1 | 1 |
| Iron | µg/L | | 210 | 59 | 60 | 33 | 66 | 66 |
| Lead | µg/L | | <0.2 | <0.1 | <0.1 | <0.2 | <0.1 | <0.1 |
| Manganese | µg/L | | 6 | 3 | 2.9 | 5 | 3.1 | 3.1 |
| Mercury | ng/L | 16 | 1.5 | 1 | <0.6 | 0.8 | <0.6 | <0.6 |
| Molybdenum | µg/L | | <1 | 6 | 6 | 9 | 5 | 5 |
| Nickel | µg/L | | <1 | 0.7 | 0.6 | <1 | 0.7 | 0.7 |
| Selenium | µg/L | | 0.3 | 0.7 | 0.8 | 0.6 | 0.7 | 0.7 |
| Silver | µg/L | | 0.05 | <0.05 | <0.05 | <0.02 | <0.05 | <0.05 |
| Strontium | µg/L | | 308 | 4050 | 4040 | 6010 | 3600 | 3600 |
| Thallium | µg/L | | <0.05 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 |
| Titanium | µg/L | | 7 | <10 | <10 | <5 | <10 | <10 |
| Tin | µg/L | | <5 | <1 | <1 | <5 | <1 | <1 |
| Uranium | µg/L | | 0.1 | 1.72 | 1.67 | 2.4 | 1.52 | 1.52 |
| Vanadium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Zinc | µg/L | | <5 | 1 | 1 | <5 | <1 | <1 |
| Zirconium | µg/L | | <0.5 | | | <0.5 | | |
| **Dissolved Metals** | | | | | | | | |
| Aluminum | µg/L | | 10 | <10 | <10 | 5 | <10 | <10 |
| Antimony | µg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Arsenic | µg/L | | 0.4 | 0.7 | 0.9 | 2.4 | 0.7 | 0.7 |
| Barium | µg/L | | 2 | 7 | 7 | 11 | 7 | 7 |
| Beryllium | µg/L | | <0.1 | <1 | <1 | <0.1 | <1 | <1 |
| Bismuth | µg/L | | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron | µg/L | | 197 | 2160 | 2240 | 2990 | 2000 | 2000 |
| Cadmium | µg/L | | 0.01 | 0.05 | <0.05 | 0.12 | <0.05 | <0.05 |
| Chromium | µg/L | | <1 | 0.8 | 0.7 | <1 | 0.7 | 0.7 |
| Cobalt | µg/L | | <0.5 | <0.1 | <0.1 | <0.5 | <0.1 | <0.1 |
| Copper | µg/L | | 0.8 | 1 | 0.9 | 0.9 | 0.9 | 0.9 |
| Iron | µg/L | | 28 | 5 | 5 | <5 | 7 | 7 |
| Lead | µg/L | | <0.2 | <0.1 | <0.1 | <0.2 | <0.1 | <0.1 |
| Manganese | µg/L | | 4 | 1.1 | 1.1 | 5 | 1.3 | 1.3 |
| Molybdenum | µg/L | | <1 | 6 | 6 | 9 | 5 | 5 |
| Nickel | µg/L | | <1 | 0.6 | 0.5 | <1 | 0.5 | 0.5 |
| Selenium | µg/L | | <0.1 | 0.8 | 1.1 | 0.4 | <0.5 | <0.5 |
| Silver | µg/L | | <0.02 | <0.05 | <0.05 | 0.05 | <0.05 | <0.05 |
| Strontium | µg/L | | 321 | 4150 | 4350 | 6230 | 3690 | 3690 |
| Thallium | µg/L | | <0.05 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 |
| Tin | µg/L | | <5 | <1 | <1 | <5 | <1 | <1 |
| Titanium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Uranium | µg/L | | <0.1 | 1.62 | 1.69 | 2.5 | 1.46 | 1.46 |
| Vanadium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Zinc | µg/L | | <5 | 2 | 2 | <5 | 2 | 2 |
| Zirconium | µg/L | | <0.5 | | | <0.5 | | |
| **Radionuclides** | | | | | | | | |
| Radium-226 | Bq/L | | <0.005 | 0.008 | <0.005 | <0.05 | <0.005 | <0.005 |
| **Other** | | | | | | | | |
| Cyanide | mg/L | | | | | | | |
| Fluoride | mg/L | | | | | | | |
| Sulphide | mg/L | | 0.007 | 0.006 | 0.006 | 0.009 | 0.006 | 0.006 |
| Silicon (total) | mg/L | | 354 | 595 | 600 | 515 | 583 | 583 |
| Silicon (dissolved) | mg/L | | 278 | 514 | 527 | 761 | 532 | 532 |
| Sulphur (total) | mg/L | | 52 | 607 | 607 | 813 | 529 | 529 |
| Sulphur (dissolved) | mg/L | | 46 | 598 | 636 | 823 | 530 | 530 |

**Notes:** Bq/L = Becquerel per litre; NTU = nephlometric turbidity units.

[a]Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 1999, 2007).

**Exceedances - Aquatic Life**

Appendix B7. Analytical results for marine water quality samples, 2008

| Parameter | Units | CWQG - Aquatic Life[a] | Roberts Bay Top | | | Roberts Bay Bottom | | |
|---|---|---|---|---|---|---|---|---|
| | | | 16-Jul-08 | 19-Aug-08 | 13-Sep-08 | 16-Jul-08 | 19-Aug-08 | 13-Sep-08 |
| **Physical** | | | | | | | | |
| Alkalinity (Total as CaCO3) | mg/L | | 25 | 63 | 82 | 26 | 61 | 83 |
| Specific Conductivity (lab) | µS/cm | | 10000 | 33000 | 33000 | 11000 | 33000 | 33000 |
| Total Dissolved Solids | mg/L | | 5400 | 21000 | 21000 | 6300 | 21000 | 21000 |
| Total Suspended Solids | mg/L | | 5 | 27 | 25 | 4 | 7 | 7 |
| Hardness (Total as CaCO3) | mg/L | | 1050 | 4550 | 4550 | 1120 | 4630 | 4630 |
| Hardness (Dissolved as CaCO3) | mg/L | | 1070 | 4680 | 4680 | 1090 | 4880 | 4880 |
| Field pH | pH Unit | 7.0 - 8.7 | 7.4 | 8.0 | 8.1 | 7.4 | 8.0 | 8.1 |
| **Nutrients** | | | | | | | | |
| Total Phosphorus | mg/L | | 0.008 | <0.05 | <0.05 | 0.008 | <0.05 | <0.05 |
| Total Kjeldahl Nitrogen | mg/L | | 0.1 | 0.08 | 0.08 | 0.11 | 0.06 | 0.06 |
| Total Nitrogen | mg/L | | 0.1 | 0.08 | 0.08 | 0.11 | 0.06 | 0.06 |
| Ammonia - N | mg/L | | 0.008 | 0.02 | 0.02 | 0.016 | 0.02 | 0.02 |
| Nitrite+Nitrate as N | mg/L | | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| Nitrite as N | mg/L | | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 | <0.005 |
| Nitrate | mg/L | 3.6 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 | <0.02 |
| **Organics** | | | | | | | | |
| Organic Carbon (dissolved) | mg/L | | 1.3 | 1.7 | 1.7 | 1.3 | <0.5 | <0.5 |
| Organic Carbon (total) | mg/L | | 1.5 | 1.5 | 1.5 | 1.2 | 1.9 | 1.9 |
| Chlorophyll a | µg/L | | 0.47 | 0.47 | 0.36 | | | |
| **Major Ions** | | | | | | | | |
| Bicarbonate | mg/L | | 31 | 99 | 99 | 32 | 100 | 100 |
| Carbonate | mg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Calcium (total) | mg/L | | 77.6 | 336 | 336 | 82.3 | 336 | 336 |
| Calcium (dissolved) | mg/L | | 79.6 | 346 | 346 | 82 | 360 | 360 |
| Chloride | mg/L | | 3200 | 11000 | 11000 | 3300 | 12000 | 12000 |
| Magnesium (total) | mg/L | | 207 | 901 | 901 | 222 | 919 | 919 |
| Magnesium (dissolved) | mg/L | | 212 | 928 | 928 | 215 | 966 | 966 |
| Potassium (total) | µg/L | | 69.1 | 275 | 275 | 74.3 | 280 | 280 |
| Potassium (dissolved) | µg/L | | 70.2 | 289 | 289 | 72 | 299 | 299 |
| Sodium (total) | µg/L | | 1780 | 7730 | 7730 | 1910 | 7890 | 7890 |
| Sodium (dissolved) | µg/L | | 1820 | 7920 | 7920 | 1840 | 8250 | 8250 |
| Sulfate | mg/L | | 430 | | | 470 | | |
| **Total Metals** | | | | | | | | |
| Aluminum | µg/L | | 106 | 26 | 26 | 123 | 21 | 21 |
| Antimony | µg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Arsenic | µg/L | 12.5 | 1.3 | 1.4 | 1.4 | 1.7 | 1.4 | 1.4 |
| Barium | µg/L | | 4 | 8 | 8 | 5 | 8 | 8 |
| Beryllium | µg/L | | <0.1 | <1 | <1 | <0.1 | <1 | <1 |
| Bismuth | µg/L | | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron | µg/L | | 826 | 2580 | 2580 | 883 | 2640 | 2640 |
| Cadmium | µg/L | 0.12 | 0.05 | 0.06 | 0.06 | 0.05 | 0.05 | 0.05 |
| Chromium | µg/L | | <1 | 1 | 1 | <1 | 0.8 | 0.8 |
| Cobalt | µg/L | | <0.5 | <0.1 | <0.1 | <0.5 | <0.1 | <0.1 |
| Copper | µg/L | | 1 | 0.8 | 0.8 | 0.9 | 0.7 | 0.7 |
| Iron | µg/L | | 182 | 57 | 57 | 181 | 46 | 46 |
| Lead | µg/L | | <0.2 | <0.1 | <0.1 | <0.2 | <0.1 | <0.1 |
| Manganese | µg/L | | 7 | 3.2 | 3.2 | 6 | 2.8 | 2.8 |
| Mercury | ng/L | 16 | 0.9 | <0.6 | <0.6 | 1.1 | 0.7 | 0.8 |
| Molybdenum | µg/L | | 2 | 7 | 7 | 2 | 8 | 8 |
| Nickel | µg/L | | <1 | 0.8 | 0.8 | <1 | 0.7 | 0.7 |
| Selenium | µg/L | | 0.4 | <0.5 | <0.5 | 0.8 | <0.5 | <0.5 |
| Silver | µg/L | | <0.02 | <0.05 | <0.05 | <0.02 | <0.05 | <0.05 |
| Strontium | µg/L | | 1250 | 5000 | 5000 | 1380 | 5070 | 5070 |
| Thallium | µg/L | | <0.05 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 |
| Titanium | µg/L | | 7 | 12 | 12 | 13 | 15 | 15 |
| Tin | µg/L | | <5 | <1 | <1 | <5 | <1 | <1 |
| Uranium | µg/L | | 0.5 | 2.07 | 2.07 | 0.5 | 2.13 | 2.13 |
| Vanadium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Zinc | µg/L | | <5 | 2 | 2 | <5 | <1 | <1 |
| Zirconium | µg/L | | <0.5 | | | <0.5 | | |
| **Dissolved Metals** | | | | | | | | |
| Aluminum | µg/L | | 7 | 40 | 40 | 8 | 29 | 29 |
| Antimony | µg/L | | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 | <0.5 |
| Arsenic | µg/L | | 0.9 | 1 | 1 | 0.9 | 1 | 1 |
| Barium | µg/L | | 4 | 9 | 9 | 4 | 9 | 9 |
| Beryllium | µg/L | | <0.1 | <1 | <1 | <0.1 | <1 | <1 |
| Bismuth | µg/L | | <1 | <1 | <1 | <1 | <1 | <1 |
| Boron | µg/L | | 843 | 2650 | 2650 | 840 | 2760 | 2760 |
| Cadmium | µg/L | | 0.02 | 0.07 | 0.07 | 0.03 | 0.07 | 0.07 |
| Chromium | µg/L | | <1 | 0.7 | 0.7 | <1 | 0.8 | 0.8 |
| Cobalt | µg/L | | <0.5 | <0.1 | <0.1 | <0.5 | <0.1 | <0.1 |
| Copper | µg/L | | 0.7 | 0.6 | 0.6 | 0.6 | 0.7 | 0.7 |
| Iron | µg/L | | 8 | <2 | <2 | 14 | <2 | <2 |
| Lead | µg/L | | <0.2 | <0.1 | <0.1 | <0.2 | <0.1 | <0.1 |
| Manganese | µg/L | | 3 | 1.1 | 1.1 | 3 | 0.8 | 0.8 |
| Molybdenum | µg/L | | 2 | 7 | 7 | 2 | 8 | 8 |
| Nickel | µg/L | | <1 | 0.6 | 0.6 | <1 | 0.5 | 0.5 |
| Selenium | µg/L | | 0.4 | <0.5 | <0.5 | 0.4 | <0.5 | <0.5 |
| Silver | µg/L | | <0.02 | <0.05 | <0.05 | 0.04 | <0.05 | <0.05 |
| Strontium | µg/L | | 1230 | 5370 | 5370 | 1280 | 5450 | 5450 |
| Thallium | µg/L | | <0.05 | <0.1 | <0.1 | <0.05 | <0.1 | <0.1 |
| Tin | µg/L | | <5 | <1 | <1 | <5 | <1 | <1 |
| Titanium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Uranium | µg/L | | 0.4 | 2.1 | 2.1 | 0.4 | 2.15 | 2.15 |
| Vanadium | µg/L | | <5 | <10 | <10 | <5 | <10 | <10 |
| Zinc | µg/L | | <5 | <1 | <1 | <5 | <1 | <1 |
| Zirconium | µg/L | | <0.5 | | | <0.5 | | |
| **Radionuclides** | | | | | | | | |
| Radium-226 | Bq/L | | | | | | | |
| **Other** | | | | | | | | |
| Cyanide | mg/L | | | | | | | |
| Fluoride | mg/L | | | | | | | |
| Sulphide | mg/L | | 0.005 | 0.006 | 0.006 | 0.007 | 0.005 | 0.005 |
| Silicon (total) | mg/L | | 447 | 566 | 566 | 443 | 587 | 587 |
| Silicon (dissolved) | mg/L | | 339 | 509 | 509 | 314 | 558 | 558 |
| Sulphur (total) | mg/L | | 172 | 761 | 761 | 185 | 757 | 757 |
| Sulphur (dissolved) | mg/L | | 183 | 775 | 775 | 190 | 805 | 805 |

**Notes:** Bq/L = Becquerel per litre; NTU = nephlometric turbidity units.

[a]Canadian Water Quality Guidelines for the Protection of Freshwater Aquatic Life (CCME 1999, 2007).

**Exceedances - Aquatic Life**

# APPENDIX B8

# MARINE WATER QUALITY GUIDELINE EXCEEDENCES

Appendix B8. Marine Water Quality Guideline Exceedances, 2004 to 2008

| Site | Date | Strata | pH | Total Hardness (mg CaCO3/L) | Total Arsenic (µg/L) | Total Cadmium (µg/L) |
|---|---|---|---|---|---|---|
| | | | CWQG 7.0-8.7 | | CWQG 12.5 ug/L | CWQG 0.12 ug/L |
| Hope Bay | 16-Jul-08 | Bottom | 7.6 | 4950 | | 0.15 |
| Roberts Bay | 14-Aug-04 | - | 7.7 | 2660 | 15.2 | |
| Roberts Bay | 16-Aug-04 | - | - | - | 13.1 | |
| Roberts Bay | 9-Sep-04 | - | 7.8 | 3250 | 22.3 | |
| Roberts Bay | 18-Aug-05 | Top | - | - | 22.1 | |
| Roberts Bay | 14-Sep-05 | Top | 7.77 | 2600 | 21.2 | |
| Roberts Bay | 31-May-06 | Middle | 7.74 | 2750 | 15.2 | |
| Roberts Bay | 20-Jul-06 | Top | 7.86 | 2870 | 13.3 | |
| Roberts Bay | 20-Jul-06 | Bottom | 7.88 | 2780 | 11.4 | |
| Roberts Bay | 12-Aug-06 | Top | 7.89 | 3440 | 25.6 | |
| Roberts Bay | 12-Aug-06 | Bottom | 7.87 | 3520 | 27.2 | |
| Roberts Bay | 11-Sep-06 | Top | 7.90 | 4490 | 23.7 | |
| Roberts Bay | 11-Sep-06 | Bottom | 7.93 | 4550 | 21.6 | |

Note: No exceedences in 2007; No exceedences in Roberts Bay 2007; Hope Bay not sampled prior to 2007

# APPENDIX C1

# RAW FISH CAPTURE DATA

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | SLSC | 54 | | | | | | | | BP | 15-Jul-08 | KRBP-02 | Koignuk River | | | C | |
| 3 | SLSC | 46 | | | | | | | | BP | 15-Jul-08 | KRBP-02 | Koignuk River | | | C | |
| 8 | NNST | 63 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 9 | NNST | 57 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 10 | SLSC | 69 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 11 | SLSC | 67 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 12 | SLSC | 68 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 13 | SLSC | 46 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 14 | SLSC | 45 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 15 | SLSC | 46 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 16 | SLSC | 45 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 17 | SLSC | 55 | | | | | | | | BP | 15-Jul-08 | KRBP-04 | Koignuk River | | | C | |
| 18 | NNST | 52 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 19 | NNST | 73 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 20 | NNST | 42 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 21 | NNST | 44 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 22 | NNST | 61 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | Parasite on head |
| 23 | NNST | 42 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 24 | NNST | 43 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 25 | NNST | 37 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 26 | NNST | 39 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 27 | NNST | 30 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 28 | NNST | 36 | | | | | | | | BP | 15-Jul-08 | KRBP-05 | Koignuk River | | | C | |
| 30 | SLSC | 45 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 31 | SLSC | 63 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 32 | SLSC | 40 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 33 | SLSC | 26 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 34 | ARGR | 60 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 35 | NNST | 70 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 36 | NNST | 57 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 37 | NNST | 56 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 38 | NNST | 55 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 39 | NNST | 39 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 40 | NNST | 30 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 41 | NNST | 29 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 42 | NNST | 21 | | | | | | | | BP | 16-Jul-08 | KRBP-06 | Koignuk River | | | C | |
| 43 | NNST | 40 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 44 | NNST | 52 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 45 | NNST | 27 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 46 | NNST | 28 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 47 | NNST | 30 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 48 | NNST | 25 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 49 | NNST | 36 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 50 | NNST | 30 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 51 | NNST | 29 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 52 | NNST | 38 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 53 | NNST | 51 | | | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | |
| 54 | BURB | 468 | 750 | 0.73 | | | | | | BP | 16-Jul-08 | KRBP-07 | Koignuk River | | | C | Skinny |
| 55 | SLSC | 40 | | | | | | | | BP | 16-Jul-08 | KRBP-08 | Koignuk River | | | C | |
| 56 | SLSC | 54 | | | | | | | | BP | 16-Jul-08 | KRBP-08 | Koignuk River | | | C | |
| 57 | SLSC | 46 | | | | | | | | BP | 16-Jul-08 | KRBP-08 | Koignuk River | | | C | |
| 59 | NNST | 30 | | | | | | | | BP | 16-Jul-08 | KRBP-09 | Koignuk River | | | C | |
| 60 | NNST | 21 | | | | | | | | BP | 16-Jul-08 | KRBP-09 | Koignuk River | | | C | |
| 61 | NNST | 42 | | | | | | | | BP | 16-Jul-08 | KRBP-09 | Koignuk River | | | C | |
| 62 | ARGR | 59 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | M | Preserved |
| 63 | NNST | 59 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 64 | NNST | 45 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 65 | NNST | 53 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 66 | ARGR | 59 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 67 | NNST | 64 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 68 | NNST | 32 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 69 | ARGR | 64 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 70 | ARGR | 53 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 71 | ARGR | 50 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 72 | SLSC | 43 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 73 | SLSC | 44 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 74 | NNST | 60 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 75 | NNST | 47 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 76 | NNST | 45 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 77 | NNST | 40 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 78 | NNST | 35 | | | | | | | | BP | 16-Jul-08 | KRBP-10 | Koignuk River | | | C | |
| 82 | LKTR | 805 | 5845 | 1.12 | | | | | | GN | 19-Jul-08 | PLGN-01 | Patch Lake | | | C | Wedge cut out of left pelvic fin |
| 83 | LKWH | 409 | 1040 | 1.52 | | | | | | GN | 19-Jul-08 | PLGN-01 | Patch Lake | | | C | |
| 84 | LKWH | 448 | 1435 | 1.60 | | | | | | GN | 19-Jul-08 | PLGN-01 | Patch Lake | | | C | |
| 85 | LKWH | 388 | 870 | 1.49 | | | | | | GN | 19-Jul-08 | PLGN-02 | Patch Lake | | | C | |
| 86 | LKWH | 390 | 800 | 1.35 | | | | | | GN | 19-Jul-08 | PLGN-02 | Patch Lake | | | C | |
| 87 | LKWH | 346 | 580 | 1.40 | | | | | | GN | 19-Jul-08 | PLGN-03 | Patch Lake | | | C | |
| 88 | LKWH | 334 | 425 | 1.14 | | | | | | GN | 19-Jul-08 | PLGN-03 | Patch Lake | | | C | |
| 89 | LKWH | 411 | 1015 | 1.46 | | | | | | GN | 19-Jul-08 | PLGN-03 | Patch Lake | | | C | |
| 90 | LKWH | 353 | 540 | 1.23 | | | | | | GN | 19-Jul-08 | PLGN-04 | Patch Lake | | | C | |
| 91 | LKWH | 299 | 340 | 1.27 | | | | | | GN | 19-Jul-08 | PLGN-04 | Patch Lake | | | C | |
| 92 | LKWH | 368 | 730 | 1.46 | | | | | | GN | 19-Jul-08 | PLGN-04 | Patch Lake | | | C | |
| 93 | LKWH | 325 | 445 | 1.30 | | | | | | GN | 19-Jul-08 | PLGN-04 | Patch Lake | | | C | |
| 94 | CISC | 267 | | | | | | | | GN | 19-Jul-08 | PLGN-04 | Patch Lake | | | C | |
| 95 | LKWH | 379 | 624 | 1.15 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 96 | LKWH | 404 | 861 | 1.31 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 97 | CISC | 279 | 235 | 1.08 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 98 | CISC | 257 | 188 | 1.11 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 99 | CISC | 225 | 120 | 1.05 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 100 | LSCS | 200 | 119 | 1.49 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 101 | CISC | 256 | 165 | 0.98 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | M | |
| 102 | CISC | 254 | 130 | 0.79 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | M | |
| 103 | CISC | 191 | 43 | 0.62 | | | | | | GN | 20-Jul-08 | PLGN-05 | Patch Lake | | | C | |
| 104 | LKTR | 660 | 2384 | 0.83 | | | Green | 3900 | 985121001832634 | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 105 | LKTR | 861 | 5701 | 0.89 | | | Green | 3901 | 985121002025405 | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 106 | LKWH | 312 | 340 | 1.12 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 107 | LKWH | 413 | 830 | 1.18 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 108 | CISC | 268 | 185 | 0.96 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 109 | LKWH | 338 | 463 | 1.20 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 110 | LKWH | 382 | 680 | 1.22 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 111 | CISC | 294 | 290 | 1.14 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 112 | CISC | 239 | 105 | 0.77 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 113 | CISC | 258 | 146 | 0.85 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 114 | CISC | 273 | 170 | 0.84 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 115 | LKWH | 287 | 204 | 0.86 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 116 | LKWH | 241 | 92 | 0.66 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 117 | LKWH | 299 | 268 | 1.00 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 118 | CISC | 248 | 104 | 0.68 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 119 | CISC | 251 | 140 | 0.89 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | C | |
| 120 | CISC | 240 | 93 | 0.67 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 121 | CISC | 236 | 93 | 0.71 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | Eaten by LKTR |
| 122 | CISC | 289 | 227 | 0.94 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 123 | CISC | 256 | 117 | 0.70 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 124 | CISC | 251 | 105 | 0.66 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 125 | CISC | 230 | 49 | 0.40 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | Skinny |
| 126 | CISC | 235 | 104 | 0.80 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 127 | CISC | 277 | 178 | 0.84 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 128 | CISC | 223 | 47 | 0.42 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | Skinny |
| 129 | CISC | 244 | 89 | 0.61 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 130 | CISC | 301 | 230 | 0.84 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 131 | CISC | 251 | | | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 132 | CISC | 283 | 163 | 0.72 | | | | | | GN | 20-Jul-08 | PLGN-06 | Patch Lake | | | M | |
| 133 | CISC | 193 | 84 | 1.17 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 134 | CISC | 198 | 121 | 1.56 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 135 | CISC | 197 | 91 | 1.19 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 136 | CISC | 181 | 100 | 1.69 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 137 | CISC | 170 | 83 | 1.69 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 138 | CISC | 299 | 131 | 0.49 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 139 | CISC | 232 | 145 | 1.16 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 140 | CISC | 199 | 96 | 1.22 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 141 | CISC | 302 | 325 | 1.18 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 142 | LKTR | 780 | 4274 | 0.90 | | | Green | 3902 | 985121001692428 | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 143 | LKTR | 637 | 2827 | 1.09 | | | Green | 3904 | 985121001830337 | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | C | |
| 144 | LKWH | 268 | 256 | 1.33 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | M | |
| 145 | CISC | 230 | 168 | 1.38 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | M | |
| 146 | CISC | 212 | 138 | 1.45 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | M | |
| 147 | CISC | 166 | 69 | 1.51 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | M | |
| 148 | CISC | 215 | 129 | 1.30 | | | | | | GN | 20-Jul-08 | PLGN-07 | Patch Lake | | | M | Partially eaten in net |
| 149 | LKTR | 820 | 6335 | 1.15 | | | Green | 3905 | 985121001921779 | GN | 22-Jul-08 | PLGN-10 | Patch Lake | | | C | Pit tag scar but reader would not read, new tag |
| 150 | LKWH | 352 | 510 | 1.17 | | | | | | GN | 22-Jul-08 | PLGN-10 | Patch Lake | | | C | |
| 151 | LKWH | 354 | 540 | 1.22 | | | | | | GN | 22-Jul-08 | PLGN-10 | Patch Lake | | | C | |
| 152 | CISC | 287 | 270 | 1.14 | | | | | | GN | 22-Jul-08 | PLGN-10 | Patch Lake | | | M | |
| 154 | LKWH | 385 | 550 | 0.96 | | | | | | GN | 22-Jul-08 | PLGN-11 | Patch Lake | | | C | |
| 155 | CISC | 265 | 190 | 1.02 | | | | | | GN | 22-Jul-08 | PLGN-11 | Patch Lake | | | M | |
| 156 | CISC | 210 | 89 | 0.96 | | | | | | GN | 22-Jul-08 | PLGN-11 | Patch Lake | | | M | |
| 158 | LKTR | 665 | 2940 | 1.00 | | | Green | 3906 | 985121002037314 | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | C | |
| 159 | LKWH | 419 | 990 | 1.35 | | | | | | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | C | |
| 160 | CISC | 224 | | | | | | | | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | C | |
| 161 | LKTR | 700 | 3945 | 1.15 | | | Green | 3907 | 985121001830485 | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | C | |
| 162 | CISC | 226 | 86 | 0.75 | | | | | | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | C | |
| 163 | LKTR | 372 | 390 | 0.76 | M | IM | | | | GN | 22-Jul-08 | PLGN-12 | Patch Lake | | | M | Kept for Heidi |
| 168 | LKTR | 669 | 2239 | 0.75 | | | Green | 3908 | 985121001835648 | GN | 23-Jul-08 | PLGN-13 | Patch Lake | | | R | Old adipose clip |
| 169 | LKWH | 355 | 476 | 1.06 | | | | | | GN | 23-Jul-08 | PLGN-13 | Patch Lake | | | C | |
| 170 | LKWH | 344 | 374 | 0.92 | | | | | | GN | 23-Jul-08 | PLGN-13 | Patch Lake | | | C | |
| 171 | CISC | 326 | 348 | 1.00 | | | | | | GN | 23-Jul-08 | PLGN-13 | Patch Lake | | | C | |
| 172 | CISC | 325 | | | | | | | | GN | 23-Jul-08 | PLGN-13 | Patch Lake | | | M | |
| 173 | LKTR | 727 | 2540 | 0.66 | | | Green | 3909 | 985121002039819 | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | Very skinny |
| 174 | LKTR | 650 | 2324 | 0.85 | | | Green | 3910 | 985121001827918 | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | Gill injury |
| 175 | LKTR | 671 | 3380 | 1.12 | | | Green | 0010 | 985121001918305 | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | R | |
| 176 | LKTR | 535 | 1633 | 1.07 | | | Green | 3911 | 985121001907226 | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | |
| 177 | CISC | 269 | 194 | 1.00 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | |
| 178 | LSCS | 246 | 113 | 0.76 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | |
| 179 | CISC | 228 | 89 | 0.75 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | |
| 180 | CISC | 269 | 182 | 0.94 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | C | |
| 181 | LKWH | 380 | 596 | 1.09 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | M | |
| 182 | CISC | 290 | | | F | M | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | M | |
| 183 | LSCS | 220 | 58 | 0.54 | M | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | M | Skinny |
| 184 | LSCS | 224 | 71 | 0.63 | M | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | M | Cysts on stomach |
| 185 | LSCS | 234 | 58 | 0.45 | | | | | | GN | 23-Jul-08 | PLGN-14 | Patch Lake | | | M | |
| 186 | CISC | 294 | 167 | 0.66 | | | | | | GN | 23-Jul-08 | PLGN-15 | Patch Lake | | | C | |
| 187 | LKWH | 390 | 753 | 1.27 | | | | | | GN | 23-Jul-08 | PLGN-15 | Patch Lake | | | C | |
| 188 | LKTR | 825 | 7544 | 1.34 | | | Green | 3912 | 985120031629252 | GN | 23-Jul-08 | PLGN-15 | Patch Lake | | | R | |
| 189 | LKTR | 935 | 11000 | 1.35 | | | Green | 3914 | 985121001872765 | GN | 23-Jul-08 | PLGN-15 | Patch Lake | | | C | |
| 190 | LKTR | 750 | 4713 | 1.12 | | | Green | 3915 | 985120031624571 | GN | 23-Jul-08 | PLGN-16 | Patch Lake | | | R | Fish in belly, could see tail |
| 191 | LKTR | 664 | 2592 | 0.89 | | | Green | 3916 | 985120031455598 | GN | 23-Jul-08 | PLGN-16 | Patch Lake | | | R | |
| 192 | LKWH | 311 | 357 | 1.19 | | | | | | GN | 23-Jul-08 | PLGN-17 | Patch Lake | | | C | |
| 193 | LKWH | 293 | 316 | 1.26 | | | | | | GN | 23-Jul-08 | PLGN-17 | Patch Lake | | | C | |
| 195 | LKTR | 815 | 4761 | 0.88 | | | Green | 3917 | 985121002047871 | GN | 25-Jul-08 | PLGN-20 | Patch Lake | | | C | |
| 196 | LKWH | 449 | 1165 | 1.29 | | | | | | GN | 25-Jul-08 | PLGN-20 | Patch Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 197 | CISC | 234 | 168 | 1.31 | | | | | | GN | 25-Jul-08 | PLGN-20 | Patch Lake | | | M | Eaten by LKTR |
| 198 | CISC | 231 | 173 | 1.40 | | | | | | GN | 25-Jul-08 | PLGN-20 | Patch Lake | | | M | Eaten by LKTR |
| 199 | LKWH | 390 | 852 | 1.44 | | | | | | GN | 25-Jul-08 | PLGN-20 | Patch Lake | | | C | |
| 200 | LKWH | 402 | 863 | 1.33 | | | | | | GN | 25-Jul-08 | PLGN-19 | Patch Lake | | | C | |
| 201 | LKTR | 263 | 186 | 1.02 | | | | | | GN | 25-Jul-08 | PLGN-18 | Patch Lake | | | C | Did not tag: not doing well |
| 202 | LKWH | 404 | 740 | 1.12 | | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 203 | LKWH | 407 | 837 | 1.24 | | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 204 | LKWH | 308 | 357 | 1.22 | | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 205 | CISC | 229 | 129 | 1.07 | | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 206 | LKTR | 740 | 3936 | 0.97 | | | Green | 3919 | 985121001229914 | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 207 | LKTR | 744 | 3761 | 0.91 | | | Green | 3920 | 985121002039941 | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | C | |
| 208 | LKWH | 403 | 805 | 1.23 | F | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | M | |
| 209 | LKWH | 431 | 909 | 1.14 | | | | | | GN | 25-Jul-08 | PLGN-21 | Patch Lake | | | M | Stomach full of sand |
| 210 | CISC | 190 | 75 | 1.09 | | | | | | GN | 25-Jul-08 | PLGN-22 | Patch Lake | | | C | |
| 211 | CISC | 210 | 85 | 0.92 | | | | | | GN | 25-Jul-08 | PLGN-22 | Patch Lake | | | C | |
| 212 | LKWH | 360 | 550 | 1.18 | | | | | | GN | 25-Jul-08 | PLGN-22 | Patch Lake | | | C | |
| 213 | CISC | 213 | 78 | 0.81 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 214 | CISC | 224 | 96 | 0.85 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 215 | CISC | 208 | 74 | 0.82 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 216 | CISC | 207 | 80 | 0.90 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 217 | CISC | 224 | 96 | 0.85 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 218 | CISC | 197 | 69 | 0.90 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 219 | CISC | 183 | 51 | 0.83 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 220 | LKWH | 465 | 1104 | 1.10 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | C | |
| 221 | LKTR | 763 | 4520 | 1.02 | | | Green | 2922 | 985120031630249 | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | R | |
| 222 | LKWH | 420 | 891 | 1.20 | M | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | M | Fat; stomach full of isopods, gammarus, chironomids |
| 223 | CISC | 264 | 201 | 1.09 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | M | |
| 224 | CISC | 199 | 61 | 0.77 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | M | |
| 225 | CISC | 214 | 81 | 0.83 | | | | | | GN | 25-Jul-08 | PLGN-23 | Patch Lake | | | M | |
| 226 | CISC | 244 | 150 | 1.03 | | | | | | GN | 25-Jul-08 | PLGN-24 | Patch Lake | | | C | |
| 227 | LKWH | 420 | 916 | 1.24 | | | | | | GN | 25-Jul-08 | PLGN-25 | Patch Lake | | | C | |
| 228 | LKTR | 695 | 3277 | 0.98 | | | Green | 2923 | 985120031581270 | GN | 25-Jul-08 | PLGN-25 | Patch Lake | | | R | |
| 229 | LKWH | 402 | | | | | | | | GN | 26-Jul-08 | PLGN-26 | Patch Lake | | | C | |
| 230 | LKWH | 405 | | | | | | | | GN | 26-Jul-08 | PLGN-26 | Patch Lake | | | C | |
| 231 | LKWH | 389 | | | | | | | | GN | 26-Jul-08 | PLGN-26 | Patch Lake | | | C | |
| 232 | LKWH | 366 | | | | | | | | GN | 26-Jul-08 | PLGN-27 | Patch Lake | | | C | |
| 233 | CISC | 268 | | | | | | | | GN | 26-Jul-08 | PLGN-27 | Patch Lake | | | C | |
| 234 | LKTR | 696 | 3017 | 0.89 | | | Green | 3924 | | GN | 26-Jul-08 | PLGN-28 | Patch Lake | | | R | Pit reader not working; has PIT scar |
| 235 | LKTR | 767 | 4261 | 0.94 | | | Green | 3926 | | GN | 26-Jul-08 | PLGN-28 | Patch Lake | | | R | Pit reader not working; has PIT scar; old bite marks |
| 236 | LKTR | 740 | 3932 | 0.97 | | | Green | 3927 | | GN | 26-Jul-08 | PLGN-28 | Patch Lake | | | R | Pit reader not working; has PIT scar |
| 237 | LKWH | 361 | 578 | 1.23 | M | | | | | GN | 26-Jul-08 | PLGN-28 | Patch Lake | | | M | Cysts on stomach |
| 238 | CISC | 273 | 236 | 1.16 | F | | | | | GN | 26-Jul-08 | PLGN-28 | Patch Lake | | | M | Cysts on stomach |
| 239 | LKWH | 406 | 835 | 1.25 | | | | | | GN | 26-Jul-08 | PLGN-29 | Patch Lake | | | C | |
| 240 | LKWH | 378 | 669 | 1.24 | | | | | | GN | 26-Jul-08 | PLGN-29 | Patch Lake | | | C | |
| 241 | LKWH | 423 | 1042 | 1.38 | | | | | | GN | 26-Jul-08 | PLGN-29 | Patch Lake | | | C | |
| 242 | LKWH | 450 | 1130 | 1.24 | | | | | | GN | 1-Aug-08 | ALGN-02 | Aimaokatalok Lake | | | C | |
| 243 | LKTR | 545 | 1269 | 0.78 | | | Green | 3928 | | GN | 1-Aug-08 | ALGN-02 | Aimaokatalok Lake | | | C | Skinny |
| 244 | CISC | 173 | 63 | 1.22 | | | | | | GN | 1-Aug-08 | ALGN-03 | Aimaokatalok Lake | | | C | |
| 245 | LKTR | 866 | 5955 | 0.92 | | | Green | 3929 | | GN | 1-Aug-08 | ALGN-06 | Aimaokatalok Lake | | | R | Old adipose clip |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 246 | NNST | 36 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 247 | NNST | 36 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 248 | NNST | 37 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 249 | NNST | 35 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 250 | NNST | 35 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 251 | NNST | 29 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 252 | NNST | 36 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 253 | NNST | 37 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 254 | NNST | 35 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 255 | NNST | 38 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 256 | NNST | 31 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 257 | NNST | 34 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 258 | NNST | 42 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 259 | NNST | 37 | | | | | | | | DN | 1-Aug-08 | ALDN-01 | Aimaokatalok Lake | | | C | |
| 260 | LKTR | 523 | 1406 | 0.98 | | | Green | 3930 | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | C | |
| 261 | LKTR | 544 | 1565 | 0.97 | | | Green | 3931 | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | C | |
| 262 | LKTR | 743 | 4544 | 1.11 | | | Green | 3932 | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | C | |
| 263 | CISC | 180 | 54 | 0.93 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 264 | CISC | 169 | 56 | 1.16 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | C | |
| 265 | LSCS | 184 | 60 | 0.96 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 266 | LSCS | 195 | 72 | 0.97 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 267 | LSCS | 181 | 57 | 0.96 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 268 | LKWH | 191 | 79 | 1.13 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 269 | CISC | 233 | 139 | 1.10 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 270 | CISC | 210 | 81 | 0.87 | | | | | | GN | 1-Aug-08 | ALGN-07 | Aimaokatalok Lake | | | M | |
| 271 | NNST | 59 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 272 | NNST | 44 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 273 | NNST | 52 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 274 | NNST | 46 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 275 | NNST | 43 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 276 | NNST | 41 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 277 | NNST | 45 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 278 | NNST | 40 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 279 | NNST | 45 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 280 | NNST | 20 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 281 | NNST | 20 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 282 | NNST | 24 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 283 | NNST | 21 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 284 | NNST | 22 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 285 | NNST | 24 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 286 | NNST | 24 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 287 | NNST | 21 | | | | | | | | BP | 2-Aug-08 | ALBP-01 | Aimaokatalok Lake | | | C | |
| 288 | LKWH | 466 | 1360 | 1.34 | | | | | | GN | 2-Aug-08 | ALGN-10 | Aimaokatalok Lake | | | C | |
| 289 | LKTR | 483 | 1204 | 1.07 | | | Green | 3933 | 985121002038034 | GN | 2-Aug-08 | ALGN-11 | Aimaokatalok Lake | | | C | |
| 290 | LKWH | 435 | 1130 | 1.37 | | | | | | GN | 2-Aug-08 | ALGN-11 | Aimaokatalok Lake | | | C | |
| 291 | LKWH | 443 | 1254 | 1.44 | | | | | | GN | 2-Aug-08 | ALGN-11 | Aimaokatalok Lake | | | C | |
| 292 | NNST | 50 | | | | | | | | BP | 2-Aug-08 | ALBP-02 | Aimaokatalok Lake | | | C | |
| 293 | NNST | 21 | | | | | | | | BP | 2-Aug-08 | ALBP-02 | Aimaokatalok Lake | | | C | |
| 294 | NNST | 20 | | | | | | | | BP | 2-Aug-08 | ALBP-02 | Aimaokatalok Lake | | | C | |
| 295 | LKWH | 419 | 1113 | 1.51 | | | | | | GN | 2-Aug-08 | ALGN-11 | Aimaokatalok Lake | | | C | |
| 296 | LKTR | 465 | 1313 | 1.31 | | | | | 985121002604989 | GN | 2-Aug-08 | ALGN-11 | Aimaokatalok Lake | | | C | Fat; full stomach |
| 297 | Coregonid spp | 39 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | Kept for identification |
| 298 | Coregonid spp | 24 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | Kept for identification |
| 299 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | Kept for identification |
| 300 | NNST | 45 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | |
| 301 | NNST | 49 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | |
| 302 | NNST | 40 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | |
| 303 | NNST | 21 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 304 | NNST | 33 | | | | | | | | SN | 2-Aug-08 | ALBS-01 | Aimaokatalok Lake | | | C | |
| 305 | NNST | 42 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 306 | NNST | 54 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 307 | NNST | 45 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 308 | NNST | 45 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 309 | NNST | 46 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 310 | NNST | 44 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 311 | NNST | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 312 | NNST | 45 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | C | |
| 313 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 314 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 315 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 316 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 317 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 318 | Coregonid spp | 28 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 319 | Coregonid spp | 33 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 320 | Coregonid spp | 36 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 321 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 322 | Coregonid spp | 33 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 323 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 324 | Coregonid spp | 31 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 325 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 326 | Coregonid spp | 24 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 327 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 328 | Coregonid spp | 31 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 329 | Coregonid spp | 26 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 330 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 331 | Coregonid spp | 28 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 332 | Coregonid spp | 26 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 333 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 334 | Coregonid spp | 28 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 335 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 336 | Coregonid spp | 31 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 337 | Coregonid spp | 22 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 338 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 339 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 340 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 341 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 342 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 343 | Coregonid spp | 33 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 344 | Coregonid spp | 37 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 345 | Coregonid spp | 27 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 346 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 347 | Coregonid spp | 25 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 348 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 349 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 350 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 351 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 352 | Coregonid spp | 36 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 353 | Coregonid spp | 24 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 354 | Coregonid spp | 25 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 355 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 356 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 357 | Coregonid spp | 31 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 358 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 359 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 360 | Coregonid spp | 25 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 361 | Coregonid spp | 27 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 362 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 363 | Coregonid spp | 25 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 364 | Coregonid spp | 32 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 365 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 366 | Coregonid spp | 33 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 367 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 368 | Coregonid spp | 34 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 369 | Coregonid spp | 31 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 370 | Coregonid spp | 41 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 371 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 372 | Coregonid spp | 34 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 373 | Coregonid spp | 24 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 374 | Coregonid spp | 29 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 375 | Coregonid spp | 35 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 376 | Coregonid spp | 30 | | | | | | | | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | | | M | |
| 493 | NNST | 53 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | Parasite in belly |
| 494 | NNST | 51 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 495 | NNST | 40 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | M | |
| 496 | NNST | 38 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 497 | NNST | 37 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 498 | NNST | 39 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 499 | NNST | 58 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 500 | NNST | 56 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 501 | NNST | 39 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 502 | NNST | 36 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 503 | NNST | 49 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 504 | NNST | 50 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 505 | NNST | 37 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 506 | NNST | 36 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 507 | NNST | 37 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 508 | NNST | 41 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 509 | NNST | 34 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 510 | NNST | 37 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 511 | NNST | 38 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 512 | NNST | 42 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 513 | NNST | 58 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 514 | NNST | 37 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 515 | NNST | 35 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 516 | NNST | 43 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 517 | NNST | 33 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 518 | NNST | 42 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 519 | NNST | 45 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 520 | NNST | 42 | | | | | | | | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | | | C | |
| 572 | LSCS | 240 | 141 | 1.02 | | | | | | GN | 3-Aug-08 | ALGN-12 | Aimaokatalok Lake | | | C | |
| 573 | LSCS | 202 | 105 | 1.27 | | | | | | GN | 3-Aug-08 | ALGN-12 | Aimaokatalok Lake | | | C | |
| 574 | LSCS | 200 | 105 | 1.31 | F | IM | | | | GN | 3-Aug-08 | ALGN-12 | Aimaokatalok Lake | | | M | |
| 575 | LKTR | 188 | 62 | 0.93 | | | | | 985121001687019 | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 576 | LKWH | 390 | 520 | 0.88 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 577 | LKWH | 467 | 1498 | 1.47 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 578 | LKWH | 425 | 983 | 1.28 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 579 | LKWH | 424 | 910 | 1.19 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 580 | LKWH | 375 | 623 | 1.18 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 581 | LKWH | 358 | 572 | 1.25 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 582 | LKWH | 465 | 1146 | 1.14 | | | | | | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | C | |
| 583 | LKTR | 530 | 1774 | 1.19 | | | Green | 3936 | 985121002023179 | GN | 3-Aug-08 | ALGN-13 | Aimaokatalok Lake | | | R | Old adipose clip |
| 584 | LKWH | 475 | 1319 | 1.23 | | | | | | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | C | |
| 585 | LKWH | 403 | 761 | 1.16 | | | | | | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | C | |
| 586 | LKWH | 392 | 749 | 1.24 | | | | | | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 587 | LKWH | 426 | 889 | 1.15 | | | | | | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | C | |
| 588 | LKWH | 421 | 968 | 1.30 | | | | | | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | M | |
| 589 | LKTR | 662 | 3009 | 1.04 | | | Green | 3937 | 985121001925327 | GN | 3-Aug-08 | ALGN-14 | Aimaokatalok Lake | | | C | |
| 590 | LKTR | 900 | 6652 | 0.91 | | | Green | 3938 | 985121002027229 | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 591 | LKTR | 293 | 253 | 1.01 | | | | | 985121002040929 | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 592 | LKTR | 863 | 6706 | 1.04 | | | Green | 3939 | 985121002002824 | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 593 | LKTR | 636 | 2018 | 0.78 | | | Green | 3940 | 985121002024029 | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 594 | LKWH | 398 | 788 | 1.25 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 595 | LKWH | 427 | 957 | 1.23 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 596 | LKWH | 413 | 807 | 1.15 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 597 | LKWH | 430 | 1068 | 1.34 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 598 | LKWH | 369 | 654 | 1.30 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 599 | LKWH | 409 | 958 | 1.40 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 600 | LKWH | 410 | 898 | 1.30 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 601 | LKWH | 418 | 1076 | 1.47 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 602 | LKWH | 378 | 787 | 1.46 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 603 | LSCS | 196 | 89 | 1.18 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 604 | LKWH | 445 | 1178 | 1.34 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 605 | CISC | 209 | 75 | 0.82 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 606 | LSCS | 189 | 67 | 0.99 | | | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | C | |
| 607 | LSCS | 181 | 66 | 1.11 | F | M | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 608 | LSCS | 195 | 74 | 1.00 | F | M | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 609 | LSCS | 184 | 61 | 0.98 | F | M | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 610 | LSCS | 178 | 60 | 1.06 | F | M | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 611 | LSCS | 202 | 77 | 0.93 | F | M | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 612 | CISC | 203 | 86 | 1.03 | M | IM | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | Pale liver |
| 613 | CISC | 234 | 132 | 1.03 | F | IM | | | | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | | | M | |
| 614 | LKTR | 793 | 3021 | 0.61 | | | Green | 3941 | 985121002040001 | DN | 3-Aug-08 | ALDN-02 | Aimaokatalok Lake | | | R | Old adipose clip |
| 616 | LKWH | 455 | | | | | | | | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | C | Weight could be off |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 617 | LKWH | 406 | 958 | 1.43 | | | | | | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | C | |
| 618 | LKWH | 481 | 1168 | 1.05 | M | | | | | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | M | Granular organs |
| 619 | LKWH | 401 | 798 | 1.24 | F | | | | | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | M | |
| 621 | LKTR | 508 | 1508 | 1.15 | | | Green | 3942 | 985121002044688 | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | C | |
| 622 | LKTR | 883 | 5973 | 0.87 | | | Green | 3943 | 985121002046763 | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | R | Old adipose clip |
| 623 | LKTR | 785 | 4863 | 1.01 | | | Green | 3944 | 985121001872133 | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | C | |
| 624 | LKTR | 643 | 2057 | 0.77 | | | Green | 3945 | 985121001921189 | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | | | C | |
| 625 | LKTR | 465 | 1039 | 1.03 | F | M | | | | GN | 3-Aug-08 | ALGN-18 | Aimaokatalok Lake | Otoliths | 14+ | M | tomach full of inverts; tapewor |
| 626 | LKTR | 306 | 298 | 1.04 | | | | | | GN | 3-Aug-08 | ALGN-20 | Aimaokatalok Lake | | | C | Not tagged; not doing well |
| 627 | LKWH | 479 | 1390 | 1.26 | | | | | | GN | 4-Aug-08 | ALGN-22 | Aimaokatalok Lake | | | C | Open wound on left side |
| 628 | LKTR | 674 | 2330 | 0.76 | | | Green | 3946 | 985121001691637 | GN | 4-Aug-08 | ALGN-22 | Aimaokatalok Lake | | | C | |
| 629 | LKWH | 461 | 1860 | 1.90 | | | | | | GN | 4-Aug-08 | ALGN-23 | Aimaokatalok Lake | | | C | Big fish |
| 630 | LKTR | 716 | 3992 | 1.09 | | | Green | 3948 | 985121002608325 | GN | 4-Aug-08 | ALGN-23 | Aimaokatalok Lake | | | C | |
| 631 | LKTR | 600 | 2237 | 1.04 | | | Green | 3949 | 985121002038648 | GN | 4-Aug-08 | ALGN-23 | Aimaokatalok Lake | | | C | |
| 632 | LKTR | 717 | 3827 | 1.04 | | | Green | 4750 | 985121001907616 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 633 | LKWH | 413 | 814 | 1.16 | | | | | | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 634 | LKWH | 499 | 1552 | 1.25 | | | | | | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 635 | LKTR | 757 | 3931 | 0.91 | | | Green | 4751 | 985121001872783 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 636 | LKTR | 729 | 3510 | 0.91 | | | Green | 4752 | 985121001200098 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 637 | LKTR | 794 | 6352 | 1.27 | | | Green | 4753 | 985121001869695 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | Had large whitefish in belly |
| 638 | LKTR | 490 | 1223 | 1.04 | | | Green | 4754 | 985121002039583 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 639 | LKTR | 445 | 1015 | 1.15 | | | | | 985121002040331 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 640 | LKWH | 477 | 1303 | 1.20 | M | M | | | | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | M | |
| 641 | LKTR | 542 | 1566 | 0.98 | | | Green | 4755 | 985121001827319 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | C | |
| 642 | LKWH | 472 | 1392 | 1.32 | | | | | | GN | 4-Aug-08 | ALGN-29 | Aimaokatalok Lake | | | C | |
| 643 | LKWH | 466 | 1237 | 1.22 | | | | | | GN | 4-Aug-08 | ALGN-29 | Aimaokatalok Lake | | | C | |
| 644 | LKWH | 444 | 1186 | 1.35 | M | M | | | | GN | 4-Aug-08 | ALGN-28 | Aimaokatalok Lake | Scales | | M | |
| 645 | LKWH | 501 | 1540 | 1.22 | | | | | | GN | 4-Aug-08 | ALGN-28 | Aimaokatalok Lake | | | C | |
| 646 | LKTR | 794 | 6352 | 1.27 | | | Green | 4753 | 985121001869695 | GN | 4-Aug-08 | ALGN-24 | Aimaokatalok Lake | | | R | Same net; same day recap |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 647 | LKTR | 198 | 86 | 1.11 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 648 | LKTR | 718 | 3363 | 0.91 | | | Green | 4756 | 985121001831716 | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 649 | LKWH | 475 | 1345 | 1.25 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 650 | LKWH | 448 | 1173 | 1.30 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 651 | LKWH | 254 | 199 | 1.21 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 652 | LKWH | 313 | 372 | 1.21 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 653 | LKWH | 313 | 369 | 1.20 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 654 | LSCS | 180 | 56 | 0.96 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 655 | LSCS | 181 | 51 | 0.86 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 656 | LKWH | 350 | 539 | 1.26 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 657 | LSCS | 186 | 51 | 0.79 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | C | |
| 658 | LSCS | 196 | 71.1 | 0.94 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | Preserved |
| 659 | CISC | 204 | 90.5 | 1.07 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | Preserved |
| 660 | CISC | 193 | 65 | 0.90 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | Preserved |
| 661 | CISC | 170 | 50.9 | 1.04 | | | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | Preserved |
| 662 | LKWH | 316 | 394 | 1.25 | F | IM | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | |
| 663 | LKWH | 321 | 399 | 1.21 | F | IM | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | |
| 664 | LKWH | 399 | 763 | 1.20 | F | IM | | | | GN | 5-Aug-08 | ALGN-31 | Aimaokatalok Lake | | | M | |
| 665 | LKTR | 450 | 902 | 0.99 | | | | | 985121001905275 | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | | | C | |
| 666 | LKTR | 600 | 2217 | 1.03 | | | Green | 4757 | 985121002003255 | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | | | C | |
| 667 | LKTR | 427 | 802 | 1.03 | | | | | 985121002003876 | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | | | C | |
| 668 | LKTR | 518 | 1293 | 0.93 | | | Green | 4758 | 985121002026458 | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | | | C | |
| 675 | LKTR | 525 | 1367 | 0.94 | | | Green | 4759 | 985121001690823 | GN | 5-Aug-08 | ALGN-33 | Aimaokatalok Lake | | | C | |
| 676 | LKTR | 743 | 3515 | 0.86 | | | Green | 4760 | 985121001688833 | GN | 5-Aug-08 | ALGN-33 | Aimaokatalok Lake | | | C | |
| 682 | NNST | 59 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |
| 683 | NNST | 35 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |
| 684 | SLSC | 33 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |
| 685 | NNST | 56 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |
| 686 | NNST | 50 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 687 | SLSC | 69 | | | | | | | | BP | 5-Aug-08 | ALBP-04 | Aimaokatalok Lake | | | C | |
| 688 | LSCS | 63 | 1.7 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-01 | Wolverine Lake | | | M | Preserved |
| 689 | LSCS | 49 | 0.7 | 0.59 | | | | | | SN | 5-Aug-08 | WVBS-01 | Wolverine Lake | | | M | Preserved |
| 690 | LSCS | 36 | 0.6 | 1.29 | | | | | | SN | 5-Aug-08 | WVBS-01 | Wolverine Lake | | | M | Preserved |
| 691 | LSCS | 46 | 0.7 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 692 | LSCS | 49 | 0.7 | 0.59 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 693 | LSCS | 48 | 0.7 | 0.63 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 694 | LSCS | 61 | 1.6 | 0.70 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 695 | LSCS | 63 | 1.7 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 696 | LSCS | 48 | 0.8 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 697 | LSCS | 49 | 0.8 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 698 | LSCS | 52 | 0.9 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 699 | LSCS | 56 | 1.2 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 700 | LSCS | 48 | 0.8 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 701 | LSCS | 49 | 0.8 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 702 | LSCS | 58 | 1.5 | 0.77 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 703 | LSCS | 66 | 1.9 | 0.66 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 704 | LSCS | 51 | 0.9 | 0.68 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Preserved |
| 705 | LSCS | 48 | 0.8 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 706 | LSCS | 48 | 0.7 | 0.63 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 707 | LSCS | 47 | 0.7 | 0.67 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 708 | LSCS | 48 | 0.7 | 0.63 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 709 | LSCS | 48 | 0.7 | 0.63 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 710 | LSCS | 47 | 0.8 | 0.77 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 711 | LSCS | 50 | 0.9 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 712 | LSCS | 50 | 0.8 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 713 | LSCS | 50 | 0.8 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 714 | LSCS | 49 | 0.7 | 0.59 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 715 | LSCS | 47 | 0.6 | 0.58 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 716 | LSCS | 50 | 0.8 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 717 | LSCS | 47 | 0.7 | 0.67 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 718 | LSCS | 47 | 0.6 | 0.58 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 719 | LSCS | 49 | 0.7 | 0.59 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 720 | LSCS | 50 | 0.8 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 721 | LSCS | 48 | 0.8 | 0.72 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 722 | LSCS | 49 | 0.7 | 0.59 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 723 | LSCS | 48 | 0.7 | 0.63 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 724 | LSCS | 52 | 0.9 | 0.64 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | Kept for Heidi |
| 725 | NNST | 42 | 0.7 | 0.94 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | |
| 726 | NNST | 43 | 0.6 | 0.75 | | | | | | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | | | M | |
| 1047 | NNST | 53 | | | | | | | | BP | 6-Aug-08 | WLBP-01 | Windy Lake | | | C | |
| 1048 | NNST | 26 | | | | | | | | BP | 6-Aug-08 | WLBP-01 | Windy Lake | | | C | |
| 1049 | NNST | 19 | | | | | | | | BP | 6-Aug-08 | WLBP-01 | Windy Lake | | | C | |
| 1050 | NNST | 29 | | | | | | | | BP | 6-Aug-08 | WLBP-01 | Windy Lake | | | C | |
| 1051 | NNST | 24 | | | | | | | | BP | 6-Aug-08 | WLBP-01 | Windy Lake | | | C | |
| 1052 | LKTR | 531 | 1019 | 0.68 | | | Green | 4761 | 985121001827341 | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1053 | LKTR | 870 | 10500 | 1.59 | | | Green | 4762 | 985121002026862 | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | C | |
| 1054 | LKTR | 374 | 564 | 1.08 | | | | | 985121001926695 | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1055 | LKTR | 358 | 483 | 1.05 | | | | | 985121001919648 | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1056 | CISC | 310 | 279 | 0.94 | | | | | | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1057 | CISC | 278 | 227 | 1.06 | | | | | | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1058 | CISC | 330 | 388 | 1.08 | | | | | | GN | 6-Aug-08 | WLGN-01 | Windy Lake | | | C | |
| 1059 | CISC | 323 | 382 | 1.13 | | | | | | GN | 6-Aug-08 | WLGN-02 | Windy Lake | | | C | |
| 1060 | CISC | 339 | 449 | 1.15 | | | | | | GN | 6-Aug-08 | WLGN-02 | Windy Lake | | | C | |
| 1061 | CISC | 281 | 231 | 1.04 | | | | | | GN | 6-Aug-08 | WLGN-02 | Windy Lake | | | C | |
| 1062 | CISC | 327 | 403 | 1.15 | F | M | | | | GN | 6-Aug-08 | WLGN-02 | Windy Lake | | | M | Cysts on stomach |
| 1063 | CISC | 285 | 284 | 1.23 | F | M | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | M | |
| 1064 | CISC | 252 | 173 | 1.08 | M | IM | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | M | |
| 1065 | CISC | 302 | 305 | 1.11 | M | M | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | M | Cysts on stomach |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1066 | CISC | 330 | 426 | 1.19 | | | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | M | |
| 1067 | CISC | 320 | 350 | 1.07 | M | M | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | | | M | |
| 1068 | LKTR | 384 | 574 | 1.01 | F | IM | | | | GN | 6-Aug-08 | WLGN-03 | Windy Lake | Otoliths | 11+ | M | |
| 1069 | LKTR | 140 | 28.9 | 1.05 | | | | | | BP | 6-Aug-08 | WLBP-02 | Windy Lake | | | C | |
| 1070 | LKTR | 80 | 4.7 | 0.92 | | | | | | BP | 6-Aug-08 | WLBP-02 | Windy Lake | | | C | |
| 1071 | LKTR | 68 | 3.2 | 1.02 | | | | | | BP | 6-Aug-08 | WLBP-02 | Windy Lake | | | C | |
| 1072 | LKTR | 70 | 3.3 | 0.96 | | | | | | BP | 6-Aug-08 | WLBP-02 | Windy Lake | | | C | |
| 1073 | NNST | 56 | 1.1 | 0.63 | | | | | | BP | 6-Aug-08 | WLBP-02 | Windy Lake | | | C | |
| 1074 | CISC | 309 | 314 | 1.06 | | | | | | GN | 6-Aug-08 | WLGN-04 | Windy Lake | | | C | |
| 1075 | CISC | 316 | 352 | 1.12 | | | | | | GN | 6-Aug-08 | WLGN-04 | Windy Lake | | | C | |
| 1076 | CISC | 320 | 318 | 0.97 | | | | | | GN | 6-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1077 | CISC | 300 | 318 | 1.18 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1078 | CISC | 341 | 511 | 1.29 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1079 | CISC | 304 | 305 | 1.09 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1080 | CISC | 300 | 301 | 1.11 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1081 | CISC | 276 | 231 | 1.10 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1082 | CISC | 290 | 254 | 1.04 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1083 | CISC | 273 | 231 | 1.14 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1084 | CISC | 298 | 322 | 1.22 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1085 | CISC | 274 | 214 | 1.04 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1086 | CISC | 301 | 282 | 1.03 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1087 | CISC | 287 | 260 | 1.10 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1088 | CISC | 309 | 317 | 1.07 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1089 | CISC | 276 | 254 | 1.21 | | | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | | | C | |
| 1090 | LKTR | 376 | 562 | 1.06 | F | M | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | Otoliths | 13+ | M | Stomach full of gammarus |
| 1091 | LKTR | 383 | 564 | 1.00 | M | IM | | | | GN | 7-Aug-08 | WLGN-05 | Windy Lake | Otoliths | 14+ | M | Gravel in stomach |
| 1092 | CISC | 314 | 302 | 0.98 | | | | | | GN | 7-Aug-08 | WLGN-06 | Windy Lake | | | C | |
| 1093 | CISC | 305 | 390 | 1.37 | | | | | | GN | 7-Aug-08 | WLGN-06 | Windy Lake | | | C | |
| 1094 | LKTR | 783 | 6000 | 1.25 | | | Green | 4763 | 985121001870348 | GN | 7-Aug-08 | WLGN-06 | Windy Lake | | | C | |
| 1095 | LKTR | 355 | 556 | 1.24 | | | | | 985121002040926 | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | C | |
| 1096 | CISC | 276 | 242 | 1.15 | | | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | C | |
| 1097 | CISC | 279 | 252 | 1.16 | | | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | C | |
| 1098 | CISC | 276 | 230 | 1.09 | M | IM | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | |
| 1099 | CISC | 225 | 119 | 1.04 | F | IM | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | |
| 1100 | CISC | 272 | 242 | 1.20 | M | M | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | Cysts on stomach |
| 1101 | CISC | 274 | 226 | 1.10 | F | M | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | stomach full of mysids |
| 1102 | CISC | 312 | 383 | 1.26 | F | M | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | Fat |
| 1103 | CISC | 312 | 298 | 0.98 | M | M | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | Skinny |
| 1104 | CISC | 344 | 551 | 1.35 | F | M | | | | GN | 7-Aug-08 | WLGN-07 | Windy Lake | | | M | Full of eggs |
| 1105 | CISC | 330 | 336 | 0.93 | | | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | C | |
| 1106 | CISC | 311 | 332 | 1.10 | | | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | C | |
| 1107 | CISC | 318 | 339 | 1.05 | | | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | C | |
| 1108 | CISC | 290 | 266 | 1.09 | | | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | C | |
| 1109 | CISC | 306 | 367 | 1.28 | M | IM | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | M | Cysts on stomach |
| 1110 | CISC | 244 | 176 | 1.21 | F | M | | | | GN | 7-Aug-08 | WLGN-08 | Windy Lake | | | M | |
| 1111 | CISC | 309 | 308 | 1.04 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1112 | CISC | 314 | 312 | 1.01 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1113 | CISC | 299 | 302 | 1.13 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1114 | CISC | 320 | 352 | 1.07 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1115 | CISC | 286 | 276 | 1.18 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1116 | CISC | 278 | 268 | 1.25 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1117 | CISC | 286 | 263 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1118 | CISC | 347 | 337 | 0.81 | | | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | C | |
| 1119 | CISC | 309 | 312 | 1.06 | F | M | | | | GN | 7-Aug-08 | WLGN-09 | Windy Lake | | | M | |
| 1120 | CISC | 250 | 151 | 0.97 | | | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | C | |
| 1121 | CISC | 291 | 235 | 0.95 | | | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | C | |
| 1122 | CISC | 293 | 282 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | C | |
| 1123 | CISC | 281 | 285 | 1.28 | M | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | |
| 1124 | CISC | 300 | 277 | 1.03 | M | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | |
| 1125 | CISC | 273 | 242 | 1.19 | M | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | Cysts on stomach |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1126 | CISC | 306 | 264 | 0.92 | M | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | Skinny |
| 1127 | CISC | 309 | 328 | 1.11 | F | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | |
| 1128 | CISC | 297 | 324 | 1.24 | M | M | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | |
| 1129 | CISC | 280 | 250 | 1.14 | M | IM | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | Cysts on organs |
| 1130 | CISC | 302 | 336 | 1.22 | M | IM | | | | GN | 7-Aug-08 | WLGN-10 | Windy Lake | | | M | |
| 1131 | CISC | 320 | 342 | 1.04 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1132 | CISC | 298 | 297 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1133 | CISC | 325 | 346 | 1.01 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1134 | CISC | 270 | 244 | 1.24 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1135 | CISC | 299 | 311 | 1.16 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1136 | CISC | 320 | 299 | 0.91 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1137 | CISC | 277 | 267 | 1.26 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1138 | CISC | 333 | 388 | 1.05 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1139 | CISC | 174 | 48 | 0.91 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1140 | CISC | 314 | 355 | 1.15 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1141 | CISC | 298 | 310 | 1.17 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1142 | CISC | 282 | 252 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1143 | CISC | 283 | 335 | 1.48 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1144 | CISC | 241 | 159 | 1.14 | | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | C | |
| 1145 | CISC | 290 | 279 | 1.14 | M | | | | | GN | 7-Aug-08 | WLGN-11 | Windy Lake | | | M | |
| 1146 | CISC | 275 | 213 | 1.02 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1147 | CISC | 258 | 189 | 1.10 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1148 | CISC | 300 | 339 | 1.26 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1149 | CISC | 295 | 317 | 1.23 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1150 | CISC | 302 | 313 | 1.14 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1151 | CISC | 295 | 308 | 1.20 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1152 | CISC | 298 | 317 | 1.20 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1153 | CISC | 286 | 261 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1154 | CISC | 283 | 260 | 1.15 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1155 | CISC | 295 | 305 | 1.19 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1156 | CISC | 278 | 262 | 1.22 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1157 | CISC | 315 | 335 | 1.07 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1158 | CISC | 336 | 363 | 0.96 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1159 | CISC | 303 | 325 | 1.17 | | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | C | |
| 1161 | CISC | 296 | 301 | 1.16 | F | M | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | M | |
| 1162 | CISC | 308 | 325 | 1.11 | F | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | M | Ripe |
| 1163 | CISC | 320 | 381 | 1.16 | F | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | M | Ripe |
| 1164 | CISC | 274 | 268 | 1.30 | M | | | | | GN | 7-Aug-08 | WLGN-12 | Windy Lake | | | M | Dark discoloured gonads |
| 1165 | LKTR | 1000 | 11500 | 1.15 | | | Green | | 985121001904538 | GN | 7-Aug-08 | WLGN-13 | Windy Lake | Fin clip | | C | |
| 1166 | LKTR | 378 | 342 | 0.63 | | | | | 985121002004740 | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1167 | CISC | 285 | 296 | 1.28 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1168 | CISC | 281 | 249 | 1.12 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1169 | CISC | 270 | 214 | 1.09 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1170 | CISC | 293 | 318 | 1.26 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1171 | CISC | 266 | 203 | 1.08 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1172 | CISC | 265 | 215 | 1.16 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1173 | CISC | 314 | 339 | 1.09 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1174 | CISC | 194 | 79 | 1.08 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1175 | CISC | 268 | 230 | 1.19 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1176 | CISC | 255 | 193 | 1.16 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1177 | CISC | 211 | 93 | 0.99 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1178 | CISC | 242 | 145 | 1.02 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1179 | CISC | 296 | 294 | 1.13 | | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | C | |
| 1180 | CISC | 249 | 152 | 0.98 | M | IM | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | |
| 1181 | CISC | 246 | 170 | 1.14 | F | M | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | |
| 1182 | CISC | 316 | 374 | 1.19 | F | | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | Stomach full of mysids; ripe |
| 1183 | CISC | 264 | 223 | 1.21 | F | M | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | Cysts on stomach |
| 1184 | CISC | 300 | 274 | 1.01 | M | IM | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | |
| 1185 | CISC | 289 | 255 | 1.06 | M | M | | | | GN | 7-Aug-08 | WLGN-13 | Windy Lake | | | M | |
| 1186 | LKTR | 895 | 8750 | 1.22 | | | Green | 4765 | 985121001690974 | GN | 7-Aug-08 | WLGN-14 | Windy Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1187 | CISC | 306 | 372 | 1.30 | | | | | | GN | 7-Aug-08 | WLGN-14 | Windy Lake | | | C | |
| 1188 | CISC | 296 | 347 | 1.34 | | | | | | GN | 7-Aug-08 | WLGN-14 | Windy Lake | | | C | |
| 1189 | CISC | 319 | 370 | 1.14 | | | | | | GN | 7-Aug-08 | WLGN-14 | Windy Lake | | | C | |
| 1191 | LKTR | 405 | 554 | 0.83 | | | | | 985121001830941 | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1192 | LKTR | 346 | 439 | 1.06 | | | | | 985121001904817 | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1193 | CISC | 288 | 247 | 1.03 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1194 | CISC | 315 | 318 | 1.02 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1195 | CISC | 259 | 166 | 0.96 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1196 | CISC | 298 | 311 | 1.18 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1197 | CISC | 265 | 228 | 1.23 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1198 | CISC | 301 | 290 | 1.06 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | Eaten by isopods |
| 1199 | CISC | 256 | 189 | 1.13 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1200 | CISC | 339 | 374 | 0.96 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1201 | CISC | 281 | 259 | 1.17 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1202 | CISC | 276 | 237 | 1.13 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1203 | CISC | 276 | 252 | 1.20 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1204 | CISC | 293 | 298 | 1.18 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1205 | LKTR | 243 | 138 | 0.96 | | | | | 985121002041105 | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | C | |
| 1206 | CISC | 278 | 254 | 1.18 | F | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | |
| 1207 | CISC | 283 | 263 | 1.16 | M | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | |
| 1208 | CISC | 295 | 323 | 1.26 | | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | |
| 1209 | CISC | 289 | 274 | 1.14 | M | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | |
| 1210 | CISC | 295 | 297 | 1.16 | F | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | |
| 1211 | CISC | 285 | 263 | 1.14 | F | | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | Eaten by LKTR; ripe |
| 1212 | CISC | 295 | 293 | 1.14 | M | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | | | M | Worms in stomach |
| 1213 | LKTR | 603 | 905 | | F | M | | | | GN | 7-Aug-08 | WLGN-15 | Windy Lake | Otoliths | 28+ | M | Dark liver |
| 1214 | LKTR | 880 | 8250 | 1.21 | | | Green | 4766 | 985121001871558 | GN | 7-Aug-08 | WLGN-16 | Windy Lake | | | C | |
| 1215 | CISC | 290 | 277 | 1.14 | | | | | | GN | 7-Aug-08 | WLGN-16 | Windy Lake | | | C | |
| 1216 | CISC | 310 | 404 | 1.36 | | | | | | GN | 7-Aug-08 | WLGN-16 | Windy Lake | | | C | Fat |
| 1217 | CISC | 295 | 291 | 1.13 | | | | | | GN | 7-Aug-08 | WLGN-16 | Windy Lake | | | C | |
| 1218 | CISC | 297 | 294 | 1.12 | M | M | | | | GN | 7-Aug-08 | WLGN-16 | Windy Lake | | | M | |
| 1219 | CISC | 294 | 239 | 0.94 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1220 | CISC | 316 | 256 | 0.81 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1221 | CISC | 287 | 254 | 1.07 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1222 | CISC | 301 | 278 | 1.02 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1223 | CISC | 314 | 278 | 0.90 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1224 | CISC | 285 | 261 | 1.13 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1225 | CISC | 294 | 280 | 1.10 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1226 | CISC | 283 | 253 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1227 | CISC | 300 | 243 | 0.90 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1228 | CISC | 316 | 239 | 0.76 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1229 | CISC | 311 | 319 | 1.06 | | | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | C | |
| 1230 | CISC | 317 | 311 | 0.98 | F | M | | | | GN | 8-Aug-08 | WLGN-17 | Windy Lake | | | M | |
| 1231 | CISC | 270 | 202 | 1.03 | | | | | | GN | 8-Aug-08 | WLGN-18 | Windy Lake | | | C | |
| 1232 | CISC | 294 | 302 | 1.19 | | | | | | GN | 8-Aug-08 | WLGN-18 | Windy Lake | | | C | |
| 1233 | CISC | 318 | 359 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-18 | Windy Lake | | | C | |
| 1234 | CISC | 290 | 257 | 1.05 | | | | | | GN | 8-Aug-08 | WLGN-18 | Windy Lake | | | C | |
| 1235 | CISC | 289 | 272 | 1.13 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1236 | CISC | 300 | 310 | 1.15 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1237 | CISC | 276 | 226 | 1.07 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1238 | CISC | 277 | 230 | 1.08 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1239 | CISC | 304 | 323 | 1.15 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1240 | CISC | 304 | 269 | 0.96 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1241 | CISC | 313 | 347 | 1.13 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1242 | CISC | 286 | 263 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1243 | CISC | 310 | 374 | 1.26 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1244 | CISC | 294 | 302 | 1.19 | | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1245 | LKTR | 362 | 453 | 0.95 | | | | | 985121001925528 | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | C | |
| 1246 | CISC | 315 | 356 | 1.14 | F | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | M | Ripe |
| 1247 | CISC | 302 | 281 | 1.02 | F | | | | | GN | 8-Aug-08 | WLGN-19 | Windy Lake | | | M | Ripe |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1248 | CISC | 294 | 286 | 1.13 | | | | | | GN | 8-Aug-08 | WLGN-20 | Windy Lake | | | C | |
| 1249 | CISC | 332 | 260 | 0.71 | | | | | | GN | 8-Aug-08 | WLGN-20 | Windy Lake | | | C | |
| 1250 | LKTR | 322 | 362 | 1.08 | | | | | 985121001024237 | GN | 8-Aug-08 | WLGN-20 | Windy Lake | | | C | |
| 1251 | CISC | 181 | 56 | 0.94 | M | IM | | | | GN | 8-Aug-08 | WLGN-20 | Windy Lake | | | M | |
| 1252 | CISC | 260 | 194 | 1.10 | F | IM | | | | GN | 8-Aug-08 | WLGN-20 | Windy Lake | | | M | Cysts on stomach |
| 1253 | CISC | 332 | | | | | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | C | |
| 1254 | CISC | 170 | 43 | 0.88 | | | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | C | |
| 1255 | LKTR | 631 | 3100 | 1.23 | | | Green | 4767 | 985121002023842 | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | C | |
| 1256 | CISC | 260 | 192 | 1.09 | M | IM | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1257 | CISC | 263 | 150 | 0.82 | M | M | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1258 | CISC | 247 | 196 | 1.30 | F | IM | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1259 | CISC | 243 | 154 | 1.07 | F | IM | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1260 | CISC | 291 | 307 | 1.25 | F | M | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1261 | CISC | 266 | 185 | 0.98 | F | M | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | | | M | |
| 1262 | LKTR | 351 | 453 | 1.05 | M | IM | | | | GN | 8-Aug-08 | WLGN-21 | Windy Lake | Otoliths | 12+ | M | Stomach full of inverts |
| 1263 | CISC | 270 | 196 | 1.00 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1264 | CISC | 280 | 277 | 1.26 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1265 | CISC | 308 | 341 | 1.17 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1266 | CISC | 292 | 328 | 1.32 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1267 | CISC | 244 | 163 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1268 | CISC | 265 | 295 | 1.59 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1269 | CISC | 310 | 322 | 1.08 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1270 | CISC | 292 | 261 | 1.05 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1271 | CISC | 287 | 262 | 1.11 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1272 | CISC | 278 | 228 | 1.06 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1273 | CISC | 306 | 278 | 0.97 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1274 | CISC | 283 | 250 | 1.10 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1275 | CISC | 277 | 225 | 1.06 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1276 | CISC | 287 | 276 | 1.17 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1277 | CISC | 315 | 341 | 1.09 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1278 | CISC | 235 | 134 | 1.03 | | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1279 | LKTR | 845 | 8500 | 1.41 | | | Green | 4768 | 985121001894105 | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | C | |
| 1280 | CISC | 291 | 303 | 1.23 | M | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | |
| 1281 | CISC | 278 | 230 | 1.07 | M | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | |
| 1282 | CISC | 296 | 289 | 1.11 | F | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | |
| 1283 | CISC | 300 | 304 | 1.13 | F | | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | Ripe |
| 1284 | CISC | 299 | 321 | 1.20 | F | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | Cysts on stomach |
| 1285 | CISC | 283 | 219 | 0.97 | F | IM | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | Cysts on stomach |
| 1286 | CISC | 300 | 331 | 1.23 | F | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | Pale eggs |
| 1287 | CISC | 280 | 214 | 0.97 | F | IM | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | M | |
| 1288 | LKTR | 430 | 820 | 1.03 | F | M | | | | GN | 8-Aug-08 | WLGN-22 | Windy Lake | Otoliths | 16+ | M | Stomach full of inverts |
| 1289 | LKTR | 870 | 10500 | 1.59 | | | Green | 4762 | 985121002026862 | GN | 8-Aug-08 | WLGN-22 | Windy Lake | | | R | Recapture from August 7 |
| 1290 | CISC | 305 | 303 | 1.07 | | | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1291 | CISC | 281 | 259 | 1.17 | | | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1292 | CISC | 263 | 200 | 1.10 | | | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1293 | CISC | 301 | 267 | 0.98 | | | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1294 | CISC | 245 | 165 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1295 | LKTR | 284 | 221 | 0.96 | | | | | 985121001687040 | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | C | |
| 1296 | CISC | 284 | 255 | 1.11 | M | M | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | M | |
| 1297 | CISC | 244 | 169 | 1.16 | M | M | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | M | |
| 1298 | CISC | 279 | 253 | 1.16 | M | M | | | | GN | 8-Aug-08 | WLGN-23 | Windy Lake | | | M | Cysts on stomach |
| 1299 | LKTR | 892 | 8400 | 1.18 | | | Green | 4769 | 985121001689365 | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | C | |
| 1300 | CISC | 308 | 315 | 1.08 | | | | | | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | C | |
| 1301 | CISC | 298 | 321 | 1.21 | | | | | | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | C | |
| 1302 | CISC | 281 | 258 | 1.16 | | | | | | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | C | |
| 1303 | CISC | 297 | 302 | 1.15 | F | M | | | | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | M | |
| 1304 | CISC | 303 | 330 | 1.19 | M | M | | | | GN | 8-Aug-08 | WLGN-24 | Windy Lake | | | M | |
| 1305 | LKTR | 388 | 628 | 1.08 | | | | | 985121001907224 | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1306 | CISC | 336 | 442 | 1.17 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1307 | CISC | 338 | 436 | 1.13 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |

## Appendix C1. Data for Individual Fish Captured, 2008

| Sample | Species | Length* (mm) | Weight (g) | Condition Factor | Sex | Maturity | Floy Tag Colour | Floy Tag Number | Pit Tag Number | Capture Method | Date | Site | Location | Ageing Structures | Age | Capture Code | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1308 | CISC | 308 | 358 | 1.23 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1309 | CISC | 305 | 318 | 1.12 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1310 | CISC | 301 | 303 | 1.11 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1311 | CISC | 300 | 297 | 1.10 | | | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | C | |
| 1312 | CISC | 326 | 388 | 1.12 | F | M | | | | GN | 8-Aug-08 | WLGN-25 | Windy Lake | | | M | |

**Method:**
AN Angling
BP Backpack Electrofishing
DN Dip Net
GN Gill Net
SN Beach Seine

**Maturity:**
M Mature
IM Immature

**Sex:** F = Female, M = Male

**Capture Codes:** C = first capture, M = mortality, R = re-capture

**Species:**
ARCH Arctic char
ARGR Arctic grayling
BURB Burbot
CISC Cisco
LKTR Lake trout
LKWH Lake whitefish
LSCS Least cisco
NNST Ninespine stickleback
SLSC Slimy sculpin
Coregonid spp YOY unconfirmed LKWH or CISC

**Condition Factor** = Weight [in g]/FL [in mm] **Length*** = Total Length for NNST
**Length*** = Fork Length for ARCH, ARGR, BURB, CISC, LKTR, LKWH, LSCS, SLSC

# APPENDIX C2

# SUMMARY STATISTICS FOR FISH CAPTURE DATA

**Appendix C2. Length, weight, and condition factor summary statistics for captured fish, 2008**

| Waterbody | Species | Length (mm) | | | | | Total Body Weight (g) | | | | | Condition Factor | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | *n* | Mean | SD | Min | Max | *n* | Mean | SD | Min | Max | *n* | Mean | SD | Min | Max |
| Aimaokatalok Lake | Cisco | 11 | 198 | 23 | 169 | 234 | 11 | 81 | 30 | 51 | 139 | 11 | 1.02 | 0.12 | 0.82 | 1.22 |
| | Coregonid spp. | 67 | 30 | 4 | 22 | 41 | - | - | - | - | - | - | - | - | - | - |
| | Lake trout | 40 | 601 | 181 | 188 | 900 | 40 | 2659 | 1975 | 62 | 6706 | 40 | 0.99 | 0.15 | 0.61 | 1.31 |
| | Lake whitefish | 50 | 412 | 62 | 191 | 501 | 49 | 958 | 379 | 79 | 1860 | 49 | 1.27 | 0.15 | 0.88 | 1.90 |
| | Least Cisco | 17 | 192 | 15 | 178 | 240 | 17 | 74 | 24 | 51 | 141 | 17 | 1.02 | 0.13 | 0.79 | 1.31 |
| | Ninespine stickleback | 79 | 39 | 10 | 20 | 59 | - | - | - | - | - | - | - | - | - | - |
| | Slimy sculpin | 2 | 51 | - | 33 | 69 | - | - | - | - | - | - | - | - | - | - |
| Koignuk River | Arctic grayling Juvenile | 6 | 56 | 5 | 50 | 64 | - | - | - | - | - | - | - | - | - | - |
| | Burbot | 1 | 468 | - | - | - | 1 | 750 | - | - | - | 1 | 0.73 | - | - | - |
| | Ninespine stickleback | 45 | 43 | 13 | 21 | 73 | - | - | - | - | - | - | - | - | - | - |
| | Slimy sculpin | 19 | 50 | 11 | 26 | 69 | - | - | - | - | - | - | - | - | - | - |
| Patch Lake | Cisco | 70 | 241 | 37 | 166 | 326 | 64 | 136 | 67 | 43 | 348 | 64 | 0.97 | 0.28 | 0.40 | 1.69 |
| | Lake trout | 27 | 702 | 138 | 263 | 935 | 27 | 3861 | 2189 | 186 | 11000 | 27 | 0.99 | 0.16 | 0.66 | 1.35 |
| | Lake whitefish | 51 | 372 | 49 | 241 | 465 | 47 | 668 | 286 | 92 | 1435 | 47 | 1.22 | 0.17 | 0.66 | 1.60 |
| | Least Cisco | 5 | 225 | 17 | 200 | 246 | 5 | 84 | 30 | 58 | 119 | 5 | 0.77 | 0.41 | 0.45 | 1.49 |
| Windy Lake | Cisco | 227 | 291 | 27 | 170 | 347 | 226 | 279 | 73 | 43 | 551 | 226 | 1.11 | 0.11 | 0.71 | 1.59 |
| | Lake trout | 31 | 481 | 272 | 68 | 1000 | 30 | 2809 | 3958 | 3 | 11500 | 30 | 1.08 | 0.21 | 0.63 | 1.59 |
| | Ninespine stickleback | 6 | 35 | 16 | 19 | 56 | - | - | - | - | - | - | - | - | - | - |
| Wolverine Lake | Least Cisco | 37 | 51 | 6 | 36 | 66 | 37 | 0.9 | 0.3 | 0.6 | 1.9 | 37 | 0.68 | 0.12 | 0.58 | 1.29 |
| | Ninespine stickleback | 2 | - | - | 42 | 43 | 2 | - | - | 0.6 | 0.7 | 2 | - | - | 0.75 | 0.94 |

# APPENDIX C3

# OBSERVED FISH DATA

## Appendix C3. Observed fish data, 2008

| Sample | Number of Fish | Species | Capture Method | Date | Site | Location | Capture Code | Capture Comment |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | NNST | BP | 14-Jul-08 | KRBP-01 | Koignuk River | O | |
| 4-7 | 4 | SLSC | BP | 15-Jul-08 | KRBP-04 | Koignuk River | O | |
| 29 | 1 | ARGR | AN | 16-Jul-08 | KRAN-08 | Koignuk River | O | |
| 58 | 1 | NNST | BP | 16-Jul-08 | KRBP-09 | Koignuk River | O | |
| 79-81 | 3 | NNST | BP | 16-Jul-08 | KRBP-10 | Koignuk River | O | |
| 153 | 1 | CISC | GN | 22-Jul-08 | PLGN-10 | Patch Lake | O | |
| 157 | 1 | LKTR | GN | 22-Jul-08 | PLGN-11 | Patch Lake | O | |
| 164 | 1 | LKTR | GN | 22-Jul-08 | PLGN-12 | Patch Lake | O | |
| 165-167 | 3 | CISC | GN | 22-Jul-08 | PLGN-12 | Patch Lake | O | |
| 194 | 1 | LKWH | GN | 23-Jul-08 | PLGN-17 | Patch Lake | O | |
| 377-383 | 7 | Coregonid spp | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | C | Released - no data |
| 384-492 | 109 | Coregonid spp | SN | 2-Aug-08 | ALBS-02 | Aimaokatalok Lake | M | Released - no data |
| 521-571 | 51 | NNST | BP | 2-Aug-08 | ALBP-03 | Aimaokatalok Lake | O | |
| 615 | 1 | LKWH | GN | 3-Aug-08 | ALGN-15 | Aimaokatalok Lake | O | |
| 620 | 1 | LKWH | GN | 3-Aug-08 | ALGN-16 | Aimaokatalok Lake | O | |
| 669-670 | 2 | LKWH | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | C | Released - no data |
| 671-673 | 3 | LSCS | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | C | Released - no data |
| 674 | 1 | CISC | GN | 5-Aug-08 | ALGN-32 | Aimaokatalok Lake | C | Released - no data |
| 677-679 | 3 | LKWH | GN | 5-Aug-08 | ALGN-33 | Aimaokatalok Lake | C | Released - no data |
| 680 | 1 | CISC | GN | 5-Aug-08 | ALGN-33 | Aimaokatalok Lake | C | Released - no data |
| 681 | 1 | LKWH | GN | 5-Aug-08 | ALGN-33 | Aimaokatalok Lake | C | Released - no data |
| 727-750 | 24 | NNST | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | C | Released - no data |
| 751-1037 | 287 | LSCS | SN | 5-Aug-08 | WVBS-02 | Wolverine Lake | C | Released - no data |
| 1038-1046 | 9 | NNST | SN | 5-Aug-08 | WVBS-01 | Wolverine Lake | C | Released - no data |
| 1160 | 1 | CISC | GN | 7-Aug-08 | WLGN-12 | Windy Lake | O | |
| 1190 | 1 | CISC | GN | 7-Aug-08 | WLGN-14 | Windy Lake | O | |

**Method:**
- AN Angling
- BP Backpack electrofishing
- GN Gill netting
- SN Beach Seining

**Species:**
- ARGR Arctic grayling
- CISC Cisco
- LKWH Lake whitefish
- LSCS Least cisco
- NNST Ninespine stickleback
- SLSC Slimy sculpin
- Coregonid spp YOY unconfirmed LKWH or CISC

**Capture Code:**
- C Captured
- M Mortality
- O Observed

# APPENDIX C4 to C9

# FISHING METHOD SPECIFIC LOCATIONS, EFFORT AND CPUE

**Appendix C4. Angling locations, effort, catch, and CPUE, 2008**

| Waterbody | Site ID | Coordinate (UTM 13W NAD83) | | Date | Effort | | | Fish Capture,CPUE | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ARGR | |
| | | Easting | Northing | | No. of rods | (h) | Total Effort (h) | n | CPUE |
| Koignuk River | KRAN-01 | 430287 | 7550050 | 14-Jul-08 | 2 | 0.83 | 1.67 | | |
| | KRAN-02 | 430058 | 7550956 | 14-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-03 | 429594 | 7553020 | 14-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-04 | 429791 | 7553955 | 15-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-05 | 429634 | 7554648 | 15-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-06 | 429620 | 7554919 | 15-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-07 | 431527 | 7545534 | 16-Jul-08 | 2 | 0.50 | 1.00 | | |
| | KRAN-08 | 431420 | 7545692 | 16-Jul-08 | 2 | 0.50 | 1.00 | 1 | 1.00 |
| | KRAN-09 | 431522 | 7545698 | 16-Jul-08 | 2 | 0.33 | 0.67 | | |
| | KRAN-10 | 431100 | 7547298 | 16-Jul-08 | 2 | 0.25 | 0.50 | | |
| | KRAN-11 | 430426 | 7549299 | 16-Jul-08 | 2 | 0.25 | 0.50 | | |
| | **Total** | | | | **2** | **4.33** | **8.67** | **1** | **0.12** |

n=number of fish captured

CPUE=catch per unit effort

CPUE=number of fish / hour

## Appendix C5. Backpack electrofishing locations, effort, catch, and CPUE, 2008

| Waterbody | Site ID | Date | Start Coordinate (UTM 13W NAD83) | | End Coordinate (UTM 13W NAD83) | | Effort | | Fish Capture, CPUE | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Arctic Grayling | | Burbot | | Lake Trout | | Ninespine Stickleback | | Slimy Sculpin | | Total | |
| | | | Easting | Northing | Easting | Northing | (m) | (s) | n | CPUE | n | CPUE | n | CPUE | n | CPUE | n | CPUE | n | CPUE |
| Aimaokatalok Lake | ALBP-01 | 02-Aug-08 | 441088 | 7500015 | 441126 | 7499749 | 267 | 627 | | | | | | | 17 | 2.71 | | | 17 | 2.71 |
| | ALBP-02 | 02-Aug-08 | 441187 | 7499667 | | | 50 | 608 | | | | | | | 3 | 0.49 | | | 3 | 0.49 |
| | ALBP-03 | 02-Aug-08 | 440280 | 7502894 | 440436 | 7503042 | 210 | 1184 | | | | | | | 28 | 2.36 | | | 28 | 2.36 |
| | ALBP-04 | 05-Aug-08 | 440991 | 7505591 | | | 100 | 1580 | | | | | | | 4 | 0.25 | 2 | 0.25 | 6 | 0.38 |
| | **Total** | | | | | | **627** | **3999** | | | | | | | **52** | **1.30** | **2** | **0.05** | **54** | **1.35** |
| Koignuk River | KRBP-01 | 14-Jul-08 | 429852 | 7551181 | 429919 | 7551064 | 146 | 536 | | | | | | | | | | | 0 | 0.00 |
| | KRBP-02 | 15-Jul-08 | 429793 | 7553952 | 429831 | 7553810 | 151 | 672 | | | | | | | | | 2 | 0.30 | 2 | 0.30 |
| | KRBP-03 | 15-Jul-08 | 429760 | 7554005 | 429790 | 7553954 | 60 | 285 | | | | | | | | | | | 0 | 0.00 |
| | KRBP-04 | 15-Jul-08 | 429634 | 7554648 | 429616 | 7554452 | 345 | 2428 | | | | | | | 2 | 0.08 | 8 | 0.66 | 10 | 0.82 |
| | KRBP-05 | 15-Jul-08 | 429524 | 7555063 | 429474 | 7555086 | 383 | 796 | | | | | | | 11 | 1.38 | | | 11 | 1.38 |
| | KRBP-06 | 16-Jul-08 | 431474 | 7545674 | 431418 | 7545692 | 350 | 2556 | 1 | 0.12 | | | | | 8 | 0.31 | 4 | 0.47 | 13 | 1.53 |
| | KRBP-07 | 16-Jul-08 | 431180 | 7546825 | | | 150 | 484 | | | 1 | 0.41 | | | 11 | 2.27 | | | 12 | 4.96 |
| | KRBP-08 | 16-Jul-08 | 430423 | 7549310 | 430428 | 7549299 | 111 | 429 | | | | | | | | | 3 | 0.70 | 3 | 0.70 |
| | KRBP-09 | 16-Jul-08 | 430258 | 7550128 | 430289 | 7550039 | 96 | 334 | | | | | | | 3 | 0.90 | | | 3 | 0.90 |
| | KRBP-10 | 16-Jul-08 | 430129 | 7550693 | | | 400 | 2946 | 5 | 0.51 | | | | | 10 | 0.34 | 2 | 0.20 | 17 | 1.73 |
| | **Total** | | | | | | **1792** | **11466** | **6** | **0.05** | **1** | **0.01** | | | **45** | **0.39** | **19** | **0.17** | **71** | **0.62** |
| Windy Lake | WLBP-01 | 06-Aug-08 | 431520 | 7555239 | 431480 | 7555323 | 140 | 849 | | | | | | | 5 | 0.59 | | | 5 | 0.59 |
| | WLBP-02 | 06-Aug-08 | 431323 | 7554638 | 431360 | 7554707 | 80 | 1540 | | | | | 4 | 0.52 | 1 | 0.06 | | | 5 | 0.65 |
| | **Total** | | | | | | **220** | **2389** | | | | | **4** | **0.52** | **6** | **0.25** | | | **10** | **1.24** |

n=number of fish captured
CPUE=catch per unit effort
CPUE=number of fish / 100s

## Appendix C6. Beach seining locations, effort, capture, and CPUE, 2008

| Waterbody | Site ID | Date | Start Coordinate (UTM 13W NAD83) | | Effort | Fish Capture, CPUE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Coregonid spp. | | Least cisco | | Ninespine stickleback | | Total | |
| | | | Easting | Northing | Area ($m^2$) | n | CPUE | n | CPUE | n | CPUE | n | CPUE |
| **Aimaokatalok Lake** | ALBS-01 | 02-Aug-08 | 440758 | 7500517 | 980 | 3 | 0.31 | | | 5 | 0.51 | 8 | 0.82 |
| | ALBS-02 | 02-Aug-08 | 440758 | 7500517 | 980 | 180 | 18.37 | | | 8 | 0.82 | 188 | 19.18 |
| | **Total** | | | | **1960** | **183** | **9.34** | | | **13** | **0.66** | **196** | **10.00** |
| **Koignuk River** | KRBS-01 | 14-Jul-08 | 429995 | 7551055 | 510 | | | | | | | 0 | 0.00 |
| | KRBS-02 | 14-Jul-08 | 430044 | 7550968 | 210 | | | | | | | 0 | 0.00 |
| | KRBS-03 | 14-Jul-08 | 430075 | 7550902 | 215 | | | | | | | 0 | 0.00 |
| | **Total** | | | | **935** | | | | | | | **0** | **0.00** |
| **Windy Lake** | WLBS-01 | 08-Aug-08 | 432272 | 7553153 | 560 | | | | | | | 0 | 0.00 |
| | WLBS-02 | 08-Aug-08 | 432305 | 7553239 | 511 | | | | | | | 0 | 0.00 |
| | **Total** | | | | **560** | | | | | | | **0** | **0.00** |
| **Wolverine Lake** | WVBS-01 | 05-Aug-08 | 434628 | 7546750 | 665 | | | 3 | 0.45 | 9 | 1.35 | 12 | 1.80 |
| | WVBS-02 | 05-Aug-08 | 434605 | 7546644 | 560 | | | 321 | 57.32 | 26 | 4.64 | 347 | 61.96 |
| | **Total** | | | | **1225** | | | **324** | **26.45** | **35** | **2.86** | **359** | **29.31** |

n=number of fish captured

CPUE=catch per unit effort

CPUE=number of fish / 24h

**Appendix C7. Dipnetting locations and catch, 2008**

| Waterbody | Site ID | Coordinate (UTM 13W NAD83) | | Date | Fish Capture | |
|---|---|---|---|---|---|---|
| | | | | | LKTR | NNST |
| | | Easting | Northing | | n | n |
| Aimaokatalok Lake | ALDN-01 | 439998 | 7503518 | 01-Aug-08 | | 14 |
| | ALDN-02 | | | 03-Aug-08 | 1 | |
| | **Total** | | | | **1** | **14** |

n=number of fish captured

# Appendix C8. Gill netting locations, effort, capture, and CPUE, 2008

| Waterbody | Site ID | Set No. | Coordinate (UTM 13W NAD83) | | Set Date | Set Time | Pull Date | Pull Time | Maximum Water Depth (m) | Minimum Water Depth (m) | Set Period (h) | Net Area ($m^2$) | No. Panels | Net Units | Mesh Sizes (cm) | Fish Capture / CPUE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | Cisco | | Lake trout | | Lake whitefish | | Least cisco | | Total | |
| | | | Easting | Northing | | | | | | | | | | | | n | CPUE | n | CPUE | n | CPUE | n | CPUE | n | CPUE |
| Aimaokatalok Lake | ALGN-01 | 1 | 440123 | 7503652 | 8/1/2008 | 09:52 | 8/1/2008 | 10:55 | 3.0 | 3.0 | 1.1 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-02 | 1 | 440209 | 7503671 | 8/1/2008 | 10:03 | 8/1/2008 | 11:02 | 7.0 | 3.3 | 1.0 | 27.9 | 3 | 0.03 | 3.81, 3.81, 5.08 | | | 1 | 29.19 | 1 | 29.19 | | | 2 | 58.38 |
| | ALGN-03 | 1 | 440361 | 7503759 | 8/1/2008 | 10:18 | 8/1/2008 | 11:10 | 7.9 | 6.0 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | 1 | 33.12 | | | | | | | 1 | 33.12 |
| | ALGN-04 | 1 | 440343 | 7503231 | 8/1/2008 | 11:54 | 8/1/2008 | 12:58 | 2.0 | 1.6 | 1.1 | 27.9 | 3 | 0.04 | 3.81, 5.08, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-05 | 1 | 440391 | 7503343 | 8/1/2008 | 12:02 | 8/1/2008 | 13:14 | 3.3 | 2.4 | 1.2 | 27.9 | 3 | 0.04 | 3.81, 5.08, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-06 | 1 | 440468 | 7503499 | 8/1/2008 | 12:10 | 8/1/2008 | 13:19 | 4.0 | 2.4 | 1.2 | 27.9 | 3 | 0.04 | 3.81, 3.81, 5.08 | | 0.00 | 1 | 24.96 | | | | | 1 | 24.96 |
| | ALGN-07 | 1 | 440390 | 7503591 | 8/1/2008 | 13:05 | 8/1/2008 | 14:45 | 4.3 | 3.5 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 6.35, 3.81 | 4 | 68.89 | 3 | 51.67 | 1 | 17.22 | 3 | 51.67 | 11 | 189.44 |
| | ALGN-08 | 1 | 440152 | 7503591 | 8/1/2008 | 13:25 | 8/1/2008 | 15:15 | 3.5 | 3.0 | 1.8 | 27.9 | 3 | 0.06 | 3.81, 3.81, 5.08 | | | | | | | | | 0 | 0.00 |
| | ALGN-09 | 1 | 440155 | 7504064 | 8/1/2008 | 13:35 | 8/1/2008 | 15:18 | 9.1 | 4.5 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 6.35, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-10 | 1 | 440970 | 7499998 | 8/2/2008 | 09:25 | 8/2/2008 | 10:39 | 2.2 | 2.2 | 1.2 | 27.9 | 3 | 0.04 | 3.81, 6.35, 3.81 | | | | | 1 | 23.27 | | | 1 | 23.27 |
| | ALGN-10 | 2 | 440970 | 7499998 | 8/2/2008 | 10:39 | 8/2/2008 | 12:30 | 2.2 | 2.2 | 1.9 | 27.9 | 3 | 0.07 | 3.81, 6.35, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-11 | 1 | 440839 | 7500159 | 8/2/2008 | 09:32 | 8/2/2008 | 10:50 | 2.4 | 1.9 | 13.3 | 27.9 | 3 | 0.46 | 3.81, 3.81, 5.08 | | | 1 | 2.16 | 2 | 4.32 | | | 3 | 6.47 |
| | ALGN-11 | 2 | 440839 | 7500159 | 8/2/2008 | 10:50 | 8/2/2008 | 12:45 | 2.4 | 1.9 | 1.9 | 27.9 | 3 | 0.07 | 3.81, 3.81, 5.08 | | | 1 | 15.11 | 1 | 15.11 | | | 2 | 30.21 |
| | ALGN-12 | 1 | 440342 | 7504895 | 8/3/2008 | 08:09 | 8/3/2008 | 9:16 | 11.0 | 9.1 | 1.1 | 27.9 | 3 | 0.04 | 3.81, 3.81, 5.08 | | | | | | | 3 | 77.11 | 3 | 77.11 |
| | ALGN-13 | 1 | 440196 | 7504490 | 8/3/2008 | 08:17 | 8/3/2008 | 9:30 | 9.2 | 5.7 | 1.2 | 27.9 | 3 | 0.04 | 3.81, 6.35, 3.81 | | | 2 | 47.18 | 7 | 165.14 | | | 9 | 212.33 |
| | ALGN-14 | 1 | 440165 | 7504134 | 8/3/2008 | 08:50 | 8/3/2008 | 10:45 | 6.8 | 4.0 | 1.9 | 27.9 | 3 | 0.07 | 6.35, 5.08, 6.35 | | | 1 | 14.98 | 5 | 74.88 | | | 6 | 89.86 |
| | ALGN-15 | 1 | 440237 | 7505168 | 8/3/2008 | 09:20 | 8/3/2008 | 11:25 | 15.0 | 7.1 | 2.1 | 27.9 | 3 | 0.07 | 3.81, 3.81, 5.08 | 3 | 41.33 | 4 | 55.11 | 10 | 137.78 | 7 | 96.44 | 24 | 330.67 |
| | ALGN-16 | 1 | 440230 | 7504540 | 8/3/2008 | 09:35 | 8/3/2008 | 12:45 | 9.5 | 4.5 | 3.2 | 27.9 | 3 | 0.11 | 3.81, 6.35, 3.81 | | | 4 | 36.26 | 4 | 36.26 | | | 8 | 72.51 |
| | ALGN-17 | 1 | 440476 | 7504062 | 8/3/2008 | 11:07 | 8/3/2008 | 13:35 | 3.2 | 2.0 | 2.5 | 27.9 | 3 | 0.09 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-17 | 2 | 440476 | 7504062 | 8/3/2008 | 13:35 | 8/3/2008 | 14:35 | 3.2 | 2.0 | 1.0 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-18 | 1 | 440457 | 7504085 | 8/3/2008 | 13:25 | 8/3/2008 | 14:25 | | | 1.0 | 27.9 | 3 | 0.03 | 3.81, 5.08, 3.81 | | | 1 | 28.70 | | | | | 1 | 28.70 |
| | ALGN-19 | 1 | 440446 | 7504085 | 8/3/2008 | 13:40 | 8/3/2008 | 14:40 | 3.5 | 3.5 | 1.0 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-20 | 1 | 440457 | 7504085 | 8/3/2008 | 14:30 | 8/3/2008 | 15:13 | 3.5 | 3.0 | 0.7 | 27.9 | 3 | 0.02 | 3.81, 5.08, 3.81 | | | 1 | 40.05 | | | | | 1 | 40.05 |
| | ALGN-21 | 1 | 440446 | 7504085 | 8/3/2008 | 14:42 | 8/3/2008 | 15:20 | 3.6 | 3.5 | 0.6 | 27.9 | 3 | 0.02 | 3.81, 3.81, 5.08 | | | | | | | | | 0 | 0.00 |
| | ALGN-22 | 1 | 440182 | 7505347 | 8/4/2008 | 10:05 | 8/4/2008 | 11:05 | 6.6 | 2.2 | 1.0 | 27.9 | 3 | 0.03 | 3.81, 3.81, 5.08 | | | 1 | 28.70 | 1 | 28.70 | | | 2 | 57.41 |
| | ALGN-23 | 1 | 440199 | 7505375 | 8/4/2008 | 10:10 | 8/4/2008 | 11:10 | 7.3 | 6.6 | 1.0 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | | | 2 | 57.41 | 1 | 28.70 | | | 3 | 86.11 |
| | ALGN-24 | 1 | 440131 | 7505661 | 8/4/2008 | 10:15 | 8/4/2008 | 12:10 | 6.6 | 2.7 | 1.9 | 27.9 | 3 | 0.07 | 3.81, 6.35, 3.81 | | | 7 | 104.83 | 3 | 44.93 | | | 10 | 149.76 |
| | ALGN-24 | 2 | 440131 | 7505661 | 8/4/2008 | 12:10 | 8/4/2008 | 13:18 | 6.6 | 2.7 | 1.1 | 27.9 | 3 | 0.04 | 3.81, 6.35, 3.81 | | | 1 | 26.09 | | | | | 1 | 26.09 |
| | ALGN-25 | 1 | 440047 | 7505472 | 8/4/2008 | 11:28 | 8/4/2008 | 13:05 | 4.2 | 3.2 | 1.6 | 27.9 | 3 | 0.06 | 3.81, 3.81, 5.08 | | | | | | | | | 0 | 0.00 |
| | ALGN-26 | 1 | 440075 | 7505436 | 8/4/2008 | 11:32 | 8/4/2008 | 13:06 | 4.3 | 4.2 | 1.6 | 27.9 | 3 | 0.05 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-27 | 1 | 440938 | 7506058 | 8/4/2008 | 13:45 | 8/4/2008 | 14:45 | 3.0 | 1.9 | 1.0 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-28 | 1 | 441423 | 7506063 | 8/4/2008 | 14:08 | 8/4/2008 | 14:53 | 3.5 | 1.6 | 0.8 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-28 | 2 | 441423 | 7506063 | 8/4/2008 | 14:53 | 8/4/2008 | 15:45 | 3.5 | 1.6 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | | | 1 | 31.89 | | | 1 | 31.89 |
| | ALGN-28 | 3 | 441423 | 7506063 | 8/4/2008 | 15:45 | 8/4/2008 | 16:20 | 3.5 | 1.6 | 0.6 | 27.9 | 3 | 0.02 | 3.81, 6.35, 3.81 | | | | | 1 | 47.84 | | | 1 | 47.84 |
| | ALGN-29 | 1 | 441164 | 7506267 | 8/4/2008 | 14:15 | 8/4/2008 | 15:00 | 4.0 | 3.8 | 0.8 | 27.9 | 3 | 0.03 | 3.81, 5.08, 3.81 | | | | | 2 | 76.54 | | | 2 | 76.54 |
| | ALGN-29 | 2 | 441164 | 7506267 | 8/4/2008 | 15:00 | 8/4/2008 | 15:54 | 4.0 | 3.8 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 5.08, 3.81 | | | | | | | | | 0 | 0.00 |
| | ALGN-30 | 1 | 440815 | 7506188 | 8/4/2008 | 14:50 | 8/4/2008 | 15:40 | 4.3 | 3.2 | 0.8 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-30 | 2 | 440815 | 7506188 | 8/4/2008 | 15:40 | 8/4/2008 | 16:10 | 4.3 | 3.2 | 0.5 | 27.9 | 3 | 0.02 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | ALGN-31 | 1 | 440294 | 7505170 | 8/5/2008 | 09:30 | 8/5/2008 | 10:50 | 16.5 | 6.5 | 1.3 | 27.9 | 3 | 0.05 | 3.81, 5.08, 3.81 | 3 | 64.58 | 2 | 43.06 | 9 | 193.75 | 4 | 86.11 | 18 | 387.50 |
| | ALGN-32 | 1 | 440011 | 7507231 | 8/5/2008 | 10:00 | 8/5/2008 | 11:25 | 15.5 | 7.4 | 1.4 | 27.9 | 3 | 0.05 | 6.35, 5.08, 6.35 | 1 | 20.26 | 4 | 81.05 | 2 | 40.52 | 3 | 60.78 | 10 | 202.61 |
| | ALGN-33 | 1 | 439960 | 7506866 | 8/5/2008 | 10:10 | 8/5/2008 | 11:35 | 7.6 | 3.7 | 1.4 | 27.9 | 3 | 0.05 | 3.81, 3.81, 5.08 | 1 | 20.26 | 2 | 40.52 | 3 | 60.78 | | | 6 | 121.57 |
| | **Total** | | | | | | | | | | **64.8** | | | **2.26** | | **13** | **5.76** | **39** | **17.28** | **55** | **24.37** | **20** | **8.86** | **127** | **56.27** |
| Patch Lake | PLGN-01 | 1 | 435539 | 7546452 | 7/19/2008 | 12:30 | 7/19/2008 | 14:35 | <5 | | 2.1 | 27.9 | 3 | 0.07 | 3.81, 5.08, 6.35 | | | 1 | 13.78 | 2 | 27.56 | | | 3 | 41.33 |
| | PLGN-02 | 1 | 435476 | 7546682 | 7/19/2008 | 12:45 | 7/19/2008 | 14:07 | <5 | | 1.4 | 27.9 | 3 | 0.05 | 3.81, 3.81, 5.08 | | | | | 2 | 42.01 | | | 2 | 42.01 |
| | PLGN-03 | 1 | 435620 | 7546752 | 7/19/2008 | 02:00 | 7/19/2008 | 15:00 | <5 | | 1.0 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | | | 3 | 86.11 | | | 3 | 86.11 |
| | PLGN-04 | 1 | 435429 | 7546845 | 7/19/2008 | 02:33 | 7/19/2008 | 15:58 | | | 1.4 | 27.9 | 3 | 0.05 | 3.81, 5.08, 6.35 | 1 | 20.26 | | | 4 | 81.05 | | | 5 | 101.31 |
| | PLGN-05 | 1 | 435940 | 7547109 | 7/20/2008 | 12:14 | 7/20/2008 | 13:20 | 20.4 | | 1.1 | 27.9 | 3 | 0.04 | 3.81, 5.08, 3.81 | 6 | 156.57 | | | 2 | 52.19 | 1 | 26.09 | 9 | 234.85 |
| | PLGN-06 | 1 | 435453 | 7547164 | 7/20/2008 | 12:19 | 7/20/2008 | 14:10 | 20.6 | 19.9 | 1.9 | 27.9 | 3 | 0.06 | 3.81, 5.08, 6.35 | 20 | 310.31 | 2 | 31.03 | 7 | 108.61 | | | 29 | 449.95 |
| | PLGN-07 | 1 | 435970 | 7547164 | 7/20/2008 | 12:22 | 7/20/2008 | 15:10 | 24.8 | 22.6 | 2.8 | 27.9 | 3 | 0.10 | 3.81, 3.81, 5.08 | 13 | 133.27 | 2 | 20.50 | 1 | 10.25 | | | 16 | 164.02 |
| | PLGN-08 | 1 | 431525 | 7553996 | 7/20/2008 | 10:40 | 7/20/2008 | 12:00 | 2.8 | 1.7 | 1.3 | 27.9 | 3 | 0.05 | 3.81, 6.35, 3.81 | | | | | | | | | 0 | 0.00 |
| | PLGN-09 | 1 | 435194 | 7548795 | 7/22/2008 | 10:55 | 7/22/2008 | 12:10 | 2.2 | 1.7 | 1.3 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | | | | | | | | | 0 | 0.00 |
| | PLGN-10 | 1 | 435565 | 7548066 | 7/22/2008 | 12:30 | 7/22/2008 | 14:10 | 6.5 | 2.5 | 1.7 | 27.9 | 3 | 0.06 | 6.35, 5.08, 6.35 | 1 | 17.22 | 1 | 17.22 | 2 | 34.44 | | | 4 | 68.89 |
| | PLGN-11 | 1 | 435617 | 7548012 | 7/22/2008 | 12:40 | 7/22/2008 | 13:55 | 10.5 | 9.1 | 1.3 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | 2 | 45.93 | | | 1 | 22.96 | | | 3 | 68.89 |
| | PLGN-12 | 1 | 434992 | 7548766 | 7/22/2008 | 12:25 | 7/22/2008 | 13:40 | 3.9 | 3.0 | 1.3 | 27.9 | 3 | 0.04 | 3.81, 3.81, 3.81 | 1 | 22.96 | | | | | | | 1 | 22.96 |
| | PLGN-12 | 2 | 434992 | 7548766 | 7/22/2008 | 13:40 | 7/22/2008 | 15:00 | 3.9 | 3.0 | 1.3 | 27.9 | 3 | 0.05 | 3.81, 3.81, 3.81 | 1 | 22.08 | 3 | 66.24 | 1 | 22.08 | | | 5 | 110.40 |
| | PLGN-13 | 1 | 435255 | 7548979 | 7/23/2008 | 09:34 | 7/23/2008 | 10:50 | 8.1 | 2.1 | 1.3 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | 2 | 45.32 | 1 | 22.66 | 2 | 45.32 | | | 5 | 113.30 |
| | PLGN-14 | 1 | 435630 | 7549170 | 7/23/2008 | 09:50 | 7/23/2008 | 11:30 | 4.2 | 4.1 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 3.81, 3.81 | 4 | 68.89 | 4 | 68.89 | 1 | 17.22 | 4 | 68.89 | 13 | 223.89 |
| | PLGN-15 | 1 | 435445 | 7548760 | 7/23/2008 | 10:00 | 7/23/2008 | 12:20 | 4.9 | 4.1 | 2.3 | 27.9 | 3 | 0.08 | 3.81, 5.08, 3.81 | 1 | 12.30 | 2 | 24.60 | 1 | 12.30 | | | 4 | 49.21 |
| | PLGN-16 | 1 | 435343 | 7548855 | 7/23/2008 | 14:30 | 7/23/2008 | 14:50 | 3.1 | 3.7 | 0.3 | 27.9 | 3 | 0.01 | 3.81, 3.81, 3.81 | | | 2 | 172.22 | | | | | 2 | 172.22 |
| | PLGN-17 | 1 | 435448 | 7548714 | 7/23/2008 | 14:40 | 7/23/2008 | 15:40 | 3.7 | 3.2 | 1.0 | 27.9 | 3 | 0.03 | 3.81, 5.08, 3.81 | | | | | 2 | 57.41 | | | 2 | 57.41 |
| | PLGN-18 | 1 | 434555 | 7549016 | 7/25/2008 | 10:05 | 7/25/2008 | 11:00 | 3.5 | 3.3 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 3.81, 5.08 | | | 1 | 31.31 | | | | | 1 | 31.31 |
| | PLGN-19 | 1 | 434531 | 7549054 | 7/25/2008 | 10:12 | 7/25/2008 | 11:05 | 4.8 | 1.9 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | | | 1 | 32.49 | | | 1 | 32.49 |
| | PLGN-20 | 1 | 434814 | 7548880 | 7/25/2008 | 10:20 | 7/25/2008 | 11:15 | 3.0 | 2.5 | 0.9 | 27.9 | 3 | 0.03 | 6.35, 5.08, 6.35 | 2 | 62.63 | 1 | 31.31 | 2 | 62.63 | | | 5 | 156.57 |
| | PLGN-21 | 1 | 435263 | 7548570 | 7/25/2008 | 12:00 | 7/25/2008 | 13:10 | 3.5 | 3.3 | 1.2 | 27.9 | 3 | 0.04 | 3.81, 5.08, 3.81 | 1 | 24.60 | 2 | 49.21 | 5 | 123.02 | | | 8 | 196.83 |
| | PLGN-22 | 1 | 435197 | 7548564 | 7/25/2008 | 12:05 | 7/25/2008 | 13:40 | 3.6 | 2.8 | 1.6 | 27.9 | 3 | 0.06 | 3.81, 3.81, 5.08 | 2 | 36.26 | | | 1 | 18.13 | | | 3 | 54.39 |
| | PLGN-23 | 1 | 435139 | 7548556 | 7/25/2008 | 12:10 | 7/25/2008 | 13:50 | 3.4 | 3.1 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 6.35, 3.81 | 9 | 155.00 | 1 | 17.22 | 2 | 34.44 | | | 12 | 206.67 |
| | PLGN-24 | 1 | 435642 | 7549263 | 7/25/2008 | 14:25 | 7/25/2008 | 15:25 | 4.8 | 4.3 | 1.0 | 27.9 | 3 | 0.03 | 3.81, 3.81, 5.08 | 1 | 28.70 | | | | | | | 1 | 28.70 |
| | PLGN-25 | 1 | 435612 | 7549246 | 7/25/2008 | 14:30 | 7/25/2008 | 15:30 | 4.8 | 4.6 | 1.0 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | 1 | 28.70 | 1 | 28.70 | | | 2 | 57.41 |
| | PLGN-26 | 1 | 435196 | 7550170 | 7/26/2008 | 09:45 | 7/26/2008 | 10:35 | 5.8 | 2.1 | 0.8 | 27.9 | 3 | 0.03 | 3.81, 6.35, 3.81 | | | | | 3 | 103.33 | | | 3 | 103.33 |
| | PLGN-27 | 1 | 435158 | 7550136 | 7/26/2008 | 09:50 | 7/26/2008 | 10:45 | 5.8 | 4.0 | 0.9 | 27.9 | 3 | 0.03 | 3.81, 3.81, 5.08 | 1 | 31.31 | | | 1 | 31.31 | | | 2 | 62.63 |
| | PLGN-28 | 1 | 435153 | 7549404 | 7/26/2008 | 10:00 | 7/26/2008 | 11:10 | 4.1 | 3.5 | 1.2 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | 1 | 24.60 | 3 | 73.81 | 1 | 24.60 | | | 5 | 123.02 |
| | PLGN-29 | 1 | 435025 | 7549485 | 7/26/2008 | 11:20 | 7/26/2008 | 12:35 | 3.0 | 2.7 | 1.3 | 27.9 | 3 | 0.04 | 6.35, 5.08, 6.35 | | | | | 3 | 68.89 | | | 3 | 68.89 |
| | **Total** | | | | | | | | | | **39.6** | | | **1.38** | | **69** | **50.06** | **27** | **19.59** | **51** | **37.00** | **5** | **3.63** | **152** | **110.27** |

# Appendix C8. Gill netting locations, effort, capture, and CPUE, 2008

| Waterbody | Site ID | Set No. | Coordinate (UTM 13W NAD83) | | Set Date | Set Time | Pull Date | Pull Time | Maximum Water Depth (m) | Minimum Water Depth (m) | Set Period (h) | Net Area ($m^2$) | No. Panels | Net Units | Mesh Sizes (cm) | Fish Capture / CPUE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | Cisco | | Lake trout | | Lake whitefish | | Least cisco | | Total | |
| | | | Easting | Northing | | | | | | | | | | | | n | CPUE | n | CPUE | n | CPUE | n | CPUE | n | CPUE |
| Windy Lake | WLGN-01 | 1 | 431457 | 7554670 | 8/6/2008 | 09:30 | 8/6/2008 | 10:55 | 4.8 | 3.5 | 1.4 | 27.9 | 3 | 0.05 | 6.35, 5.08, 6.35 | 3 | 60.78 | 3 | 60.78 | | | | | 6 | 121.57 |
| | WLGN-02 | 1 | 431434 | 7554540 | 8/6/2008 | 09:35 | 8/6/2008 | 11:05 | 9.7 | 3.8 | 1.5 | 27.9 | 3 | 0.05 | 3.81, 3.81, 6.35 | 4 | 76.54 | | | | | | | 4 | 76.54 |
| | WLGN-03 | 1 | 431372 | 7554424 | 8/6/2008 | 09:40 | 8/6/2008 | 11:20 | 5.5 | 5.5 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 3.81, 5.08 | 5 | 86.11 | 2 | 34.44 | | | | | 7 | 120.56 |
| | WLGN-04 | 1 | 431361 | 7554226 | 8/6/2008 | 14:00 | 8/6/2008 | 15:15 | 13.0 | 3.0 | 1.3 | 27.9 | 3 | 0.04 | 3.81, 6.35, 3.81 | 2 | 45.93 | | | | | | | 2 | 45.93 |
| | WLGN-05 | 1 | 431338 | 7554125 | 8/6/2008 | 14:10 | 8/6/2008 | 15:50 | 11.6 | 5.7 | 1.7 | 27.9 | 3 | 0.06 | 6.35, 5.08, 6.35 | 14 | 241.11 | 2 | 34.44 | | | | | 16 | 275.56 |
| | WLGN-06 | 1 | 431260 | 7554066 | 8/6/2008 | 14:17 | 8/6/2008 | 16:40 | 4.9 | 3.9 | 2.4 | 27.9 | 3 | 0.08 | 3.81, 3.81, 5.08 | 2 | 24.09 | 1 | 12.04 | | | | | 3 | 36.13 |
| | WLGN-07 | 1 | 431430 | 7554029 | 8/6/2008 | 15:30 | 8/6/2008 | 16:50 | 18.9 | 6.5 | 1.3 | 27.9 | 3 | 0.05 | 3.81, 6.35, 3.81 | 9 | 193.75 | 1 | 21.53 | | | | | 10 | 215.28 |
| | WLGN-08 | 1 | 431200 | 7553990 | 8/7/2008 | 08:45 | 8/7/2008 | 9:50 | 5.3 | 4.1 | 1.1 | 27.9 | 3 | 0.04 | 3.81. 6.35, 3.81 | 6 | 158.97 | | | | | | | 6 | 158.97 |
| | WLGN-09 | 1 | 431264 | 7553819 | 8/7/2008 | 08:55 | 8/7/2008 | 10:15 | 14.5 | 12.0 | 1.3 | 27.9 | 3 | 0.05 | 3.81, 3.81, 5.08 | 9 | 193.75 | | | | | | | 9 | 193.75 |
| | WLGN-10 | 1 | 431021 | 7553830 | 8/7/2008 | 09:05 | 8/7/2008 | 11:00 | 4.7 | 4.6 | 1.9 | 27.9 | 3 | 0.07 | 6.35, 5.08, 6.35 | 11 | 164.73 | | | | | | | 11 | 164.73 |
| | WLGN-11 | 1 | 431214 | 7553655 | 8/7/2008 | 10:00 | 8/7/2008 | 12:17 | 13.2 | 9.4 | 2.3 | 27.9 | 3 | 0.08 | 3.81, 6.35, 3.81 | 15 | 188.56 | | | | | | | 15 | 188.56 |
| | WLGN-12 | 1 | 430969 | 7553666 | 8/7/2008 | 10:20 | 8/7/2008 | 13:00 | 7.3 | 4.7 | 2.7 | 27.9 | 3 | 0.09 | 3.81, 3.81, 5.08 | 18 | 193.75 | | | | | | | 18 | 193.75 |
| | WLGN-13 | 1 | 431350 | 7553453 | 8/7/2008 | 11:13 | 8/7/2008 | 14:00 | 17.2 | 12.4 | 2.8 | 27.9 | 3 | 0.10 | 6.35, 5.08, 6.35 | 19 | 195.94 | 2 | 20.63 | | | | | 21 | 216.57 |
| | WLGN-14 | 1 | 430960 | 7553155 | 8/7/2008 | 12:25 | 8/7/2008 | 14:45 | 14.8 | 7.7 | 2.3 | 27.9 | 3 | 0.08 | 3.81, 6.35, 3.81 | 3 | 36.90 | 1 | 12.30 | | | | | 4 | 49.21 |
| | WLGN-15 | 1 | 431055 | 7553001 | 8/7/2008 | 13:10 | 8/7/2008 | 15:25 | 18.5 | 17.8 | 2.3 | 27.9 | 3 | 0.08 | 3.81, 3.81, 5.08 | 19 | 242.39 | 4 | 51.03 | | | | | 23 | 293.42 |
| | WLGN-16 | 1 | 431027 | 7553188 | 8/7/2008 | 15:00 | 8/7/2008 | 16:40 | 17.5 | 4.3 | 1.7 | 27.9 | 3 | 0.06 | 3.81, 6.35, 3.81 | 4 | 68.89 | 1 | 17.22 | | | | | 5 | 86.11 |
| | WLGN-17 | 1 | 432248 | 7552671 | 8/8/2008 | 08:50 | 8/8/2008 | 10:20 | 11.2 | 9.8 | 1.5 | 27.9 | 3 | 0.05 | 3.81, 6.35, 3.81 | 12 | 229.63 | | | | | | | 12 | 229.63 |
| | WLGN-18 | 1 | 432261 | 7552520 | 8/8/2008 | 09:00 | 8/8/2008 | 11:10 | | | 2.2 | 27.9 | 3 | 0.08 | 3.81, 3.81, 5.08 | 4 | 52.99 | | | | | | | 4 | 52.99 |
| | WLGN-19 | 1 | 432226 | 7552375 | 8/8/2008 | 09:08 | 8/8/2008 | 11:50 | 12.1 | 10.5 | 2.7 | 27.9 | 3 | 0.09 | 6.35, 5.08, 6.35 | 12 | 127.57 | 1 | 10.63 | | | | | 13 | 138.20 |
| | WLGN-20 | 1 | 432180 | 7552213 | 8/8/2008 | 10:30 | 8/8/2008 | 12:40 | 13.6 | 11.4 | 2.2 | 27.9 | 3 | 0.08 | 3.81, 6.35, 3.81 | 4 | 52.99 | 1 | 13.25 | | | | | 5 | 66.24 |
| | WLGN-21 | 1 | 432193 | 7551983 | 8/8/2008 | 11:15 | 8/8/2008 | 13:15 | 13.8 | 13.4 | 2.0 | 27.9 | 3 | 0.07 | 3.81, 3.81, 5.08 | 8 | 114.82 | 2 | 28.70 | | | | | 10 | 143.52 |
| | WLGN-22 | 1 | 432277 | 7551835 | 8/8/2008 | 11:55 | 8/8/2008 | 14:20 | 11.1 | 8.0 | 2.4 | 27.9 | 3 | 0.08 | 6.35, 5.08, 6.35 | 24 | 285.06 | 3 | 35.63 | | | | | 27 | 320.69 |
| | WLGN-23 | 1 | 431805 | 7551989 | 8/8/2008 | 12:55 | 8/8/2008 | 15:40 | 17.2 | 12.9 | 2.8 | 27.9 | 3 | 0.10 | 3.81, 6.35, 3.81 | 8 | 83.50 | 1 | 10.44 | | | | | 9 | 93.94 |
| | WLGN-24 | 1 | 431602 | 7551764 | 8/8/2008 | 13:45 | 8/8/2008 | 16:00 | 14.3 | 13.6 | 2.3 | 27.9 | 3 | 0.08 | 3.81, 3.81, 5.08 | 5 | 63.79 | 1 | 12.76 | | | | | 6 | 76.54 |
| | WLGN-25 | 1 | 431517 | 7551506 | 8/8/2008 | 15:25 | 8/8/2008 | 16:57 | 10.1 | 6.4 | 1.5 | 27.9 | 3 | 0.05 | 6.35, 5.08, 6.35 | 7 | 131.04 | 1 | 18.72 | | | | | 8 | 149.76 |
| | **Total** | | | | | | | | | | **49.0** | | | **1.71** | | **227** | **132.93** | **27** | **15.81** | | | | | **254** | **148.74** |

n=number of fish captured

CPUE= catch per unit effort

1 net unit=100 $m^2$ of net set for 24 h

CPUE=number of fish / net unit

## Appendix C9. Minnow trapping locations, effort, captures, and CPUE, 2008

| Waterbody | Site ID | Set Coordinates (UTM 13W NAD83) | | Set Date | Set Time | Pull Date | Pull Time | Set Period (h) | Fish Captures/CPUE | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Total | |
| | | Easting | Northing | | | | | | n | CPUE |
| Windy Lake | WLMT-01 | 431168 | 7552463 | 08-Aug-08 | 8:35 | 12-Aug-08 | 9:45 | 97.00 | 0 | 0.00 |
| | WLMT-02 | 431168 | 7552443 | 08-Aug-08 | 8:35 | 12-Aug-08 | 9:45 | 97.00 | 0 | 0.00 |
| | **Total** | | | | | | | **194.00** | **0** | **0.00** |

n=number of fish captured

CPUE=catch per unit effort

CPUE=number of fish / 24 h